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Enhancing Science Education through Extracurricular Activities: A Retrospective Study of "Suzy Science and the Whiz Kids©"

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A Retrospective Study of "Suzy Science and the Whiz Kids©"

by

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Abstract

Extracurricular activities (ECA) are informal settings offering free-choice experiences that are generally voluntary, open-ended, non-sequential, self-directed, hands-on, and evaluation-free. This mixed methods study investigates participation in a high school science ECA by collecting the memories of former student members for their perceptions of engagement as well as social positioning. First, this study examines the levels in which the science club engaged these members, particularly females, in science and teaching. Second, the study also ascertains how participation in the club allowed members to explore new identities and fostered the development of new skills, actions and behaviors, expanding possible future trajectories of identification, specifically in science- and education-related career fields.

Based on a review of the related literature regarding engagement and identity formation and the reconstructed reality from the memories of these students and sponsor, a theoretical framework has been constructed, based on seven essential elements of informal learning for an engaging as well as a socially constructive high school science ECA. The most significant findings are 1) the high correlation between engagement, specifically, cognitive engagement with social positioning, 2) the important role of emotional engagement in science ECA, 3) the major perception roadblocks to science learning that can be overcome, particularly for females in physical science, and 4) the importance of the teacher-student interactions in science ECA.

Articulating a theoretical framework to legitimate the power of informal learning structures may help other educators to understand the potential benefits of science ECA and thus, increase opportunities for such experiential activities in order to enhance engagement and expand positioning of their students in science. More engaging, socially constructive science ECA have the potential to enhance science education.

Suzy Science and the Whiz Kids

To all the former members of

"Suzy Science and the Whiz Kids©"

who inspired thousands of children

with the wonders of science

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Table of Contents

Enhancing Science Education through Extracurricular Activities:

A Retrospective Study of Suzy Science and the Whiz Kids©

List of Tables and Figures

Enhancing Science Education through Extracurricular Activities:

A Retrospective Study of Suzy Science and the Whiz Kids©

Figure Titles Page

Chapter One: Introduction

There are several major areas of concern encountered in science education today. The Trends in Mathematics and Science Study (TIMSS; American Institute for Research, 2007) reports a lack of progress in science achievement and the National Assessment of Educational Progress (Nations' Report Card, 2005) reports falling science scores for secondary science. Notwithstanding the poor test scores on national assessments, the concerns within science education are more specific and include the decreasing engagement of students in scientific endeavors or pursuits (Murphy & Whitelegg, 2006), reduced levels of hands-on experimentation utilized in science instruction or relegated to science fair competitions (Sumrall & Schillinger, 2004), declining numbers of females entering scientific fields (National Science Foundation, 2007), and fewer individuals choosing to enter a science teaching profession. McCarthy (2006) has warned future shortages of American scientists and engineers will affect our national security. All schools must address these concerns in science education.

Cognitive research by Bruer (1993) asserts that educators need to keep pace with society and its expectations and teach higher order thinking skills. He insists that teachers need new pedagogical tools and methods as well as better ways of interacting with students. After his tour of the fifty best schools in the nation, Kreischer (1998) asserts that schools need to help students learn how to learn, to cultivate reflectiveness in learners, and to emphasize knowledge application, not just its acquisition. He admonishes schools to nurture self-directed, independent learners who set their own goals, design their own learning plans, and evaluate their own progress. In addition, Kreischer (1998) states that schools must provide authentic, experiential learning events where students can experiment with new concepts, take risks, make mistakes, fine tune their understanding, be creative, and apply knowledge to new situations. Goldberg, Haase, Shoukas and Schramm (2006) have redefined the role of the classroom instructor from a ‘lecturer,’ responsible for delivering the core curriculum to a ‘facilitator’ at the center of an active learning environment. When it comes to an active learning environment, Oliver-Hoyo and Allen (2006) assert that achievement and attitude are positively interdependent and that affective variables are as important as cognitive variables in shaping student learning.

Engagement

In order for students to learn, Salomon, Perkins and Globerson (1991) assert that students must be mindfully engaged, actively participating in classroom activities, and accepting responsibility for learning. Numerous researchers as far back as Dewey (1916) have examined engagement of students in learning activities and the positive aspects of typical extracurricular activities (ECA) for students, but without much conformity to a standard definition of engagement. The Center for Comprehensive School Reform and Improvement in the National Office of Elementary and Secondary Education acknowledges that “Positive student engagement is not an easy term to define, yet it is known when it is seen” (p. 242). The Center is referring to Newmann’s (1986) definition, that students are engaged when they “devote substantial time and effort to a task, when they care about the quality of their work, and when they commit themselves because the work seems to have significance beyond its personal instrumental value” (p. 242).

Working with predominantly Caucasian third - sixth grade children from a suburban elementary school district in upstate New York, Skinner and Belmont (1993) separated motivational engagement from cognitive engagement that refers to the level of thinking skills used by students. They explained that engagement includes both behavioral and emotional components, stating that

> Children who are engaged show sustained behavioral involvement in learning activities accompanied by positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest (p. 573).

Within their ecological systems theory study, Gilman, Meyers, and Perez (2004) minimally define *engagement* as any activity that is initiated to attain an outcome. Weiss, Little and Bouffard (2005) have developed a precise participation equation from their study of out-of-school activities for youth ages 5-18, where attendance without engagement does not reflect true participation. They define engagement during the school day as involving both behaviors (such as persistence, effort, and attention) and emotions (such as enthusiasm, interest, and pride in success), echoing Skinner and Belmont's (1993) arguments. Their study continues to identify key factors in ECA, or extracurricular activities that foster engagement, but does not define engagement in ECA.

The most comprehensive definition of engagement is offered by Fredricks, Blumenfeld, and Paris (2004) who offer distinct components of student engagement:

> *Behavioral engagement* draws on the idea of participation; it includes involvement in academic and social or extracurricular activities and is considered crucial for achieving positive academic outcomes and preventing dropping out.
> *Cognitive engagement* draws on the idea of investment; it incorporates thoughtfulness and willingness to exert the effort necessary to comprehend

> complex ideas and master difficult skills.
> *Emotional engagement* encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do work. (p. 61)

After isolating behavioral, cognitive and emotional engagement, they recommend studying engagement as a multifaceted construct based on these components, each of which also contains multiple definitions. Although clear conceptual definitions of engagement are elusive, Fredricks, Blumenfeld, and Paris' (2004) definition and components of student engagement will be used for this study. These authors urge that greater examination of how students behave, think and feel will allow educators to more finely craft interventions to increase engagement. If knowing how students behave, think and feel is needed to design an effective ECA, then social positioning that impacts how students behave, think and feel must also be considered.

Identity Formation and Social Positioning

Engaging students in the subject matter, particularly emotionally, also must also address the social nature of learning. As individuals grow and mature to assume places in society, they are subject to considerable maneuvering, or 'positioning' into social niches (Wertsch, 1991; Bruner, 1990). Vygotsky, according to Wertsch (1991), proposes that positioning of individuals into their social roles, the views they will hold of themselves within the social culture, and thus, the actions they take are influenced through social interactions. Learning, including voluntary attention, logical memory, and formation of concepts first occurs through interpersonal interactions, then within the individual.

This socio-cultural 'positioning' begins in the home as parents impose boundaries upon their children, based on their own experiences, attitudes and beliefs. While positions become more delineated and offer the affordance (help or aid) of clear expectations, their boundaries become more constraining of the trajectories of possible future positions that could result from them. Related to the positioning done by parents is the work of Bishop, Bishop and Bishop (2004) who contend that parents advocate ECA because they teach teamwork, time management, self-discipline, and other skills important later in life and on the job.

Later as individuals assimilate into a culture defined by their peers, social positioning further shapes the individuals' actions and define their thoughts, attitudes, and beliefs about the importance of many things. Peer interactions define distinct boundaries of micro-social positions that may include, but are not limited to 'nerds', 'geeks', 'jocks', 'airheads', 'princesses', 'burn-outs', and 'drop-outs' (Barber, Eccles & Stone, 2001; Barlow, 2007; Cross, 2005; Eccles & Barber, 1999; Eccles, Barber, Stone & Hunt, 2003; Eckert, 1989). These micro-social positioning alignments occur, according to Bishop, Bishop, and Bishop (2004), through peer harassment, school engagement, crowd selection and school norms. Eckert's (1989) study of five high schools in Detroit suburbs shows that princess, jocks, burn-outs and other labels are applied to teenagers by their peers, parents, teachers, and themselves, which affect their thoughts, actions, expectations and acceptable behaviors. Peers exert considerable pressure to conform to defined positions and the acceptable social actions within those prescribed boundaries. Positioning by parents, peers and schools based on their attitudes, abilities or physical attributes causes confusion for students, who at the same time are also trying to find their own best fit in position and identity.

Positions once defined, however, become the identity framework with distinct boundaries from which to interpret other scenarios, present and future situations as well as those trajectories of opportunities, such as evidenced by Bamberg (2004). While identities ascribed by others restrain boundaries in participants' lives, Sutherland (2005) shows how education enables negotiation beyond those boundaries. Barber, Eccles, and Stone (2001) examined young adult participation in high school activities and identity groups as predictors of later substance use, psychological adjustment, and educational and occupational outcomes. They found both participation and identity may consolidate specific skills, attitudes, values, and social networks that have a far-ranging impact on the transition to adulthood. Larose, Ratelle, Guay, Senécal, and Harvey (2006) studied the association between the development of late adolescents' self-efficacy beliefs toward science, and vocational and academic adjustment (i.e., career decidedness, scientific interests, science achievement, and persistence in science), while considering the potential moderating role of gender. Their study shows that students with high stable or increasing self-efficacy trajectories report the most positive academic and vocational outcomes. Position boundaries constrain the trajectories of identification (career aspirations, educational opportunities, and future self images) available to individuals while education offers the affordance of a wider range of possible trajectories.

Conceding this benefit of education, Brown (2006) first asserts that today's students engage with the world differently than students twenty years ago. Technological devices allow them to satisfy their curiosity on their own. He states that this independent learning will be essential for their future well-being, since they are likely to have multiple careers and need to continually learn new skills that were not taught in school. Brown (2006) argues that these challenges would require educators to re-conceptualize parts of the educational system and to find ways to reinforce learning outside of formal schooling. Pedretti (2006) agrees with this last portion, maintaining that science centers, museums, nature centers, community-based science programs, and other informal science settings can all contribute to understanding of scientific knowledge and attitudes towards science. These institutions offer free-choice experiences that are typically voluntary, open-ended, non-sequential, self-directed, hands-on, and evaluation-free. Zoldosova and Prokop (2006) show that field science education may be one of the most effective ways to increase student interest and motivation in studying science. Steffes (2004) advocates structured experiential learning that gives students opportunities to test knowledge and concepts beyond the walls of the classroom.

Thus, if learning is viewed as a continuum from formal classroom instruction to informal extracurricular activities that encompass a wide range of learning opportunities and benefits, extracurricular activities or clubs may offer an additional venue to provide opportunities in science education for engaging students and for allowing them to explore new possible positions and trajectories. Extracurricular activities (ECA) encompass a broad and diverse range of youth activities for ages preschool to pre-college, and with a range of interests from athletics, academics, humanities, social and service clubs. These activities can take place outside the regular school days, may be held on or off school grounds, and may be sponsored by school personnel or outside experts.

Despite the wide range of variability, exhaustive documentation of the engagement of students in extracurricular activities has been made (Broh, 2002; Eccles, Barber, Stone & Hunt, 2003; Holland & Andre, 1987; Silliker & Quirk, 1997). Participation in extracurricular activities has been studied with respect to a) the influence of teachers and their expectations (Munro & Elsom, 2000); b) the influence of parents and activity selection (Mo & Singh, 2008); and c) attitudes toward science, scientists and career options (Chinn & Iding, 1997; Ellis, 1993). Studies have also investigated the impact of ECA on student identity, self-concept and career aspirations (Darling, Caldwell & Smith, 2005; Eckert, 1989; and Guest & Schneider, 2003). The literature on ECA also addresses the issues of student positioning. Studies examine socialization processes, costumes, role-play and volunteerism (Lindsay, 1984; Marsh & Kleitman, 2002; and Janoski, Musick & Wilson, 1998). My research question is formed: How can ECA be used to enhance science education?

Purpose of the Study

My goal is to understand how a particular ECA enhanced science education by affecting engagement and altering positions and trajectories of identification. The purpose of this mixed methods study then is twofold. First, this study collected the memories of students who participated in a particular high school science ECA as adolescents for their perceptions about the nature of their a) engagement, namely, behavioral, cognitive and emotional; and b) positioning into possible future trajectories of identification. This study looked in retrospect at the ways in which the club engaged students in science and teaching while expanding their social communications processing skills. The study also looked at ways in which participation in the club allowed students to explore new identities and potentially offered them opportunities to develop future trajectories of identification, trajectories with different skill sets, actions and behaviors with respect to real-world positions, specifically, as science experts and teachers.

A secondary purpose of this study is to propose a theoretical framework of an engaging and socially constructive high school science ECA from the results of the literature review and the reconstructed reality from the students' memories. This theoretical framework incorporates the benefits while minimizing the limitations of such activities as revealed in the literature and reflections. Articulating a theoretical framework to legitimate the power of informal learning structures may help other educators to understand the potential benefits of science ECA and thus, increase opportunities for such experiential activities in order to enhance engagement and expand positioning of their students in science.

Scope of the Study

The scope of this study is limited to the investigation of one high school extracurricular science club called "Suzy Science and the Whiz Kids©." This extracurricular club took place in a large suburban middle-lower class public high school (approximately 2,300 students) for ten years and in a small private upper-class high school (approximately 500 students) for four years in the suburbs of a large Midwestern city. Four hundred thirty-one students were involved in the program over time. Dressed in colorful costumes, high school students visited local elementary schools and presented science concepts to the elementary school students. Squads of four to six high school students, named the Whiz Kids, each focused on a different physical science topic, were scheduled sequentially into classrooms to present their individual science demonstrations. Elementary children were encouraged to assist with the demonstrations and Whiz Kids were trained in ways to engage all the children in their presentations. During its years of operation, the club was also invited to present at science festivals, PTA science nights, science fairs, Boy Scout banquets, Girl Scout badge workshops as well as several national celebration events, such as American Education Week at local malls and National Chemistry Week at the St. Louis Science Center. It has been more than twenty-five years since the first members were involved in the club and ten years since the last presentations were made.

Significance of the Study

The potential for enhancing science education through extracurricular activities provides the impetus for this investigation. This study is significant in that it addresses several of the major areas of concern encountered in science education today. These concerns include decreasing engagement of students in scientific endeavors or pursuits, reduced levels of hands-on experimentation utilized in science instruction or relegated to science fair competitions, declining numbers of females entering scientific fields, and fewer individuals choosing a science teaching profession. Memories and perceptions regarding the nature of their engagement and positioning as members of this particular club have been collected and examined. My detailed records as the creator/sponsor and memories about the club development and implementation offer a further interpretive lens to unpack the elements and theories that offer explanations about the impact of informal learning on engagement and identity trajectories.

The results of this study shed new light on the role of the various factors and importance of engagement within ECA. It confirms that science still has much to learn about structuring an ECA to mindfully engage students, meet their needs, influence their social positions, and encourage and challenge their academic interests beyond the classroom. Based on the disparity between general, non-science ECA and science ECA, this new information also provides better guidelines for science teachers trying to enhance science education through ECA. This includes simple actions or processes, such as actively recruiting quiet or reticent students, those who have not yet voiced strong or any interests in science, particularly females, improving emotional engagement among students through social groupings and shared responsibilities, and making it ‘fun’. It includes assigning student groups to encourage new patterns of interactions, using only core guidelines for project-based learning, and using costumes or historical figures to enhance positioning through public group presentations.

More effective science ECA can also impact classroom instruction by increasing presentations designed and justified by students, allowing greater student inquiry explorations, or incorporating a spiraling curriculum with more repetitions to cement concept attainment. The findings from this study that tapped into the memories of students who participated in one unique extracurricular club and examined the nature of their engagement and positioning has the potential to change the way science teachers interact and work with their students and to increase student science achievement while improving attitudes, thus enhancing science education.

Chapter Two: Review of Related Literature

Engagement in ECA

Engagement has been extensively studied, yet a clear concise definition of the term has not yet reached consensus by researchers. Salomon, Perkins, and Globerson (1991) assert that cognitive effects are dependent on the mindful engagement of learners. Fredricks, Blumenfeld, and Paris (2004) have assembled a comprehensive collection of previous studies of engagement in order to increase understanding of the concept and how engagement can be fostered to a higher degree in students. Their multi-component definition serves as the framework for this study. Although this particular study investigates a high school club, consideration is given to the findings of related studies at other grade levels.

Behavioral Engagement: Introduction

The range of studies conducted on behavioral engagement are extensive, albeit generally within the classroom, and mirror the range of ECA. Behavioral engagement in extracurricular activities may be evidenced as participating, attending functions regularly, following the rules, behaving appropriately and staying on-task. It also includes being flexible, volunteering effort, working with a group to complete tasks, making contributions or leading discussions and projects for a group. Behavioral engagement (BE) includes observable behaviors that can be documented in attendance records, permission notes, annual reports, leadership and club rosters, dues payments, and discipline forms. Numerous empirical studies on ECA participation have documented the potential benefits of behavioral engagement as gains in psychological development, life skills and social networks as well as a decrease in problem behaviors for students participating in these activities. These benefits have been shown to be particularly significant for those students at-risk or from lower socio-economic backgrounds.

From a historical perspective, Dewey (1916) supports extracurricular school activities for leadership opportunities and school spirit. Wanlass (2000) finds that leadership roles and responsibilities for students is a necessary component for growth and development and Harragan (1977, p. 222) insists it is particularly important for girls to compete in modern society.

Behavioral Engagement: Benefits

Psychological Development. The first benefit for participation and behavioral engagement in ECA is fostering students' psychological development and healthy lifestyles. Counselors promote ECA as "appropriate, efficient and effective ways to . . . maximize the development of individual potentialities," according to Silliker and Quirk (1997, p. 292) in their coed study of predominantly white high school (grades 9-12) soccer players from five rural schools in western New York. Studying Childhood and Beyond (CAB) longitudinal adolescent study data for primarily white middle-class adolescents in grades 7-12 over a three-year period, Fredricks and Eccles (2006) indicate that greater involvement in extracurricular activities is associated with academic adjustment, psychological competencies, and a positive peer context with the strongest results for the oldest group of students. Mihaly Csikzentmihalyi, author of the book *Becoming Adult: How Teenagers Prepare for the World of Work*, in an interview with Scherer (2002), states in ECA:

> Students say that they are doing something that is important to them. The activity is voluntary to a large extent. Kids can choose to do things that match their own interests and skills. So they are doing something fun. But at the same time they are doing work to adult specifications (p. 14).

His work is based on longitudinal studies made with 6th, 8th, 10th, and 12th grade students in 12 schools from Florida to California. To help develop student potentials, Csikzentmihalyi (1999) urges educators to do more group work, to foster curiosity, and to increase engagement.

Life Skills. The second benefit from ECA participation is the development and refinement of life skills. "ECA participation and behavioral engagement can refine certain skills, attitudes, values and social networks that have far ranging impact on student transition to adulthood," according to Barber, Eccles, and Stone (2001, p. 429) in their analysis of the Michigan Study of Adolescent Life Transitions database. McLaughlin and Irby (1994) find similar results in their investigation with young people and grassroots youth advocates in more than 60 youth organizations serving approximately 24,000 youth in three large western metropolitan areas. From data analyses of the National Educational Longitudinal Study of 1988 (NELS:88), Broh (2002) asserts that "repeated successes in sports develop self-confidence and maturity, which transfer into academic pursuits" (p. 71). According to Harrison and Narayan's (2003) voluntary statewide survey in 2001 of 50,168 ninth grade public school students, ECA participants are significantly more likely to have healthy life styles than non-participants.

Similar findings that the life skills and psychological benefits of ECA increase with non-sports activities and with increasing longevity of involvement appear across school age levels. They are affirmed by studies of very young students, such as that of Simpkins, Ripke, Huston, and Eccles (2005) in a comparative CAB study of Kindergarten - third grade children from diverse socioeconomic neighborhoods. Posner and Vandell (1999) concur with those findings in their two-year study of approximately 200 third to fifth grade students from low-income households; and finally participation in ECA by progressively older students is found effective in the work cited by Darling, Caldwell, and Smith (2005), using secondary data from a larger survey study in nine high schools in California and Wisconsin.

Decrease in Problem Behaviors. The third benefit is that behavioral engagement and ECA participation are also generally accompanied by a decrease in problem behaviors. Utilizing the data from the Carolina Longitudinal Study of 695 students in seven public middle schools in southeastern U.S., Mahoney (2000) suggests that "peer processes in ECA may play an important role in decreasing deviant or anti-social behavior" (p. 514). This deviant or anti-social behavior includes adolescents' use of marijuana, drugs or alcohol (Caldwell & Darling, 1999; Darling, Caldwell, & Smith, 2005; Feldman & Matjasko, 2005; Hoffman, 2006; McNeely, Nonnemaker, & Blum, 2002; and Shann, 2001). Darling, Caldwell, and Smith (2005) report that 1) marijuana is used, albeit moderately, by students in sports ECA compared to the lowest use of marijuana by students who are in non-sport ECA; and 2) there is a direct correlation between those students experiencing the most positive adjustment, improved grades and attitudes toward school and highest academic aspirations and those students participating in non-sport ECA. Reports also show that ECA participation a decrease in problem behavior such as adolescent fighting and other criminal activity (Mahoney & Stattin, 2000; and Zierold, Garman, & Anderson, 2005) and also decreases early school dropouts (Broh, 2002; McNeal, 1995; McNeely, Nonnemaker, & Blum, 2002; Pinhey, Perez, & Workman, 2002; and Zierold, Garman, & Anderson, 2005).

The impact of ECA participation and behavioral engagement has also been studied for students who work and watch TV. Although working students do not exhibit lower grades, higher absenteeism, or more school tardiness than their nonworking peers, they are significantly more likely to cut classes and not take part in ECA, thus, missing the benefit of ECA participation, according to Zierold, Garman and Anderson (2005) who studied 7,506 students from five school districts across Wisconsin. Shann (2001) studying middle school students and Posner and Vandell (1999) studying elementary school children both find that students who do not participate in ECA or who participate only in informal ECA spend considerably more time watching television each day. Cooper, Valentine, Nye and Lindsay (1999), after surveying 424 sixth to 12th grade students in three school districts (one urban, one suburban and one rural) in Tennessee, state more specifically that television watching has a negative effect on achievement and impairs school identity acquisition. Comparing TV viewing habits of 570 adolescents who had been preschool participants in one of two studies of television viewing by young children, Anderson, Huston and Schmitt (2001) clarify the impact of television watching. While contending that early TV watching breeds passive behavior, they argue that it is important to note that students are watching programs that reflect their interests. According to their study of preschoolers and adolescents, students who often watch informative television programs participate in more academic and service ECA with leadership opportunities, those who watch sports television generally participate in athletic ECA, while those who watch violent entertainment programs participate less frequently.

Behavioral Engagement: A Summary

To summarize, behavioral engagement in ECA fosters psychological development and healthy lifestyles. It refines skills, attitudes and values important in adulthood and helps to develop confidence and maturity that transfer to academic pursuits. Behavioral engagement in ECA reduces problem behaviors, such as substance abuse, early school dropout, and anti-social behaviors, such as fighting and delinquency. Students who work or watch excessive TV miss the benefits of ECA participation and behavioral engagement. While many studies show the benefits of ECA participation increase with longevity, longevity of ECA participation is not clearly defined as being measured in weeks, months or years.

Several studies cite the benefits of behavioral engagement in ECA as being particularly significant for low-income, urban, high-risk children (Mahoney & Stattin, 2000; McNeal, 1995; Reis, Colbert, & Hebert, 2005), those from disadvantaged backgrounds (Darling, Caldwell, & Smith, 2005; Everson & Millsap, 2004; Marsh & Kleitman, 2002; and McNeal, 1998), or those students underserved in regular school environmental constraints (Everson & Millsap, 2004; Marsh & Kleitman, 2002; McNeely, Nonnemaker, & Blum, 2002; and Olszewski-Kubilius & Seon-Young, 2004).

The benefits of behavioral engagement in ECA have also been touted as assuaging various risk factors for adolescents. Based on “learning from people” (p. 36) through nine case studies of high-achieving female students in an urban high school, Reis, Colbert, and Hebert (2005) classify 34 risk factors for adolescents into five groups, namely “personal pain, academic failure (linked to inappropriate or too easy content in elementary school), family tragedy, family socioeconomic status, and family instability”

(p. 110-114). The valuable gains from ECA participation prompt Reis, Colbert, and Hebert (2005) to recommend that underachievers be required to volunteer or to join ECA. They maintain that busier students are less likely to underachieve in schools. These studies of behavioral engagement verify the many benefits accrued by students for participation in ECA.

Cognitive Engagement: Introduction

ECA studies are grouped in this study, not only according to behavioral engagement, which deals with attending, participating and contributing to groups, but also according to cognitive engagement, as suggested by Fredricks, Blumenfeld, and Paris's (2004) multiple-component recommendation. Cognitive engagement deals with the students' thoughtful and intentional investment and intent to make the effort, to contribute and to master challenges and skills set before them. Their study characterizes cognitive engagement as the students' intentional decision to participate and is evidenced by working beyond expectations, willingness to take on challenging tasks, mastering skills and concepts, reasoning, educational aspirations beyond the classroom, competencies, deliberate choices, and persistent effort toward life goals and values. Many researchers have studied academic achievement, the major benefit attributed to cognitive engagement. For this study, cognitive engagement is examined in two parts; its characteristics, namely, the ECA participant characteristics (those who choose to participate in ECA), reasons given for choosing to join ECA, and persistence in ECA, and the last part deals with academic achievement.

Cognitive Engagement: Evidences

Participant Characteristics. The first aspect of cognitive engagement in ECA reviews the characteristics of those students who choose to engage in ECA. Using a large database, the National Educational Longitudinal Study (1988) that collects data from fourth and eighth grade students with follow-ups every two years, McNeal (1998) finds that students from higher socioeconomic schools are less likely to participate in school ECA and more likely to participate in non-school activities; higher-ability students are likely to be involved in a variety of ECA; and minority students participate as much or more than white students.

Olszewski-Kubilius and Seon-Young (2004) studying 247 gifted students in grade 4-11 who attended a Midwestern university summer program, find that boys choose to participate more in science, science-related, and academic clubs while girls are more involved in drama, theater, art and dance; there is greater sustained involvement in talent-related clubs, competitions and volunteer work than in sports. McNeal (1998), studying high school students and Posner and Vandell (1999), studying elementary school children, both find that girls are more likely than boys to choose to participate in ECA (except in sports). Meanwhile Darling, Caldwell, and Smith (2005) studying high school students and Simpkins, Ripke, Huston, and Eccles (2005), studying elementary school children in four middle-class communities in Detroit, Michigan, both find that boys are more likely than girls to participate in ECA, but that girls decide to participate in a greater variety of ECA. Hossler and Stage (1992), studying a representative sample of 3,843 ninth grade students from 21 high schools in Indiana, find that girls have higher GPAs, are more involved in ECA, and have higher educational expectations.

Studying 31 ninth grade classrooms in junior highs schools and 33 ninth grade classrooms in senior high schools in Mississippi, Gifford and Dean (1990) report that ninth-grade students are more active in a wider range of ECA and derive more personal satisfaction when located in a middle school setting than when ninth-grade placement is in a high school setting. Darling, Caldwell, and Smith (2005) note that freshmen are more apt to name sports as their favorite ECA while seniors name extracurricular clubs yet dominate varsity sports. Fredricks and Eccles (2006), using previous CAB survey data of a longitudinal study of white upper socioeconomic class female students with highly-educated mothers and fathers in Michigan, document that the ECA benefits are also more pronounced for older high school students. Swanson (2002), analyzing data from a national sample of students and schools as well as Guest and Schneider (2003) using five-year longitudinal data for middle school and high school students from Alfred P. Sloan Study of Youth and Social Development, discover that many students engage in ECA as investments or portfolio-building for college matriculation purposes, choosing activities deliberately to maximize significant life goals.

Reasons for Joining. Another important aspect of cognitive engagement besides participant characteristics is the reasons that students give for choosing, or making a commitment to join ECA, such as those examined by Olszewski-Kubilius and Seon-Young (2004). They summarize several studies that assess student motives; reasons include 1) individual motivation and desire to satisfy needs; 2) challenge not available in academic classes; 3) emotional satisfaction and enjoyment such that it leads to pursuit of a career; 4) time management and other skills learned in ECA are helping them in school classes (p. 108). The reasons that students participate may also be evidenced in the common characteristics that all successful youth organizations share, which, according to McLaughlin and Irby (1994) in their study of 60 urban sanctuaries examined in three metropolitan areas, are “dynamic adult leadership, family-like environments, challenging activities, flexibility, attunement to youngsters' needs, and youth empowerment goals” (p. 300). In fact, McLaughlin and Irby (1994) offer considerable specific insight into what urban students want in their ECA: 1) Group rules that stress commitment, integrity, and responsibility to the group, as well as to oneself; 2) Clear and firm discipline and authority, based on a minimal number of rules; 3) Opportunity to be worthy of trust and to earn respect; 4) Chance to learn the needed skills, attitudes, and values; 5) A group and a purpose that means something to them; and 6) Caring and well-meaning leaders. Similarly, after a longitudinal study of 695 students with 25% African-Americans from five communities in the southeast, Mahoney (2000) suggests that effective youth activities all “have 1) high organization and structure, 2) regular meetings, 3) an emphasis on increasingly complex skill-building as an activity goal, and 4) leadership by one or more competent adults” (p. 514).

Persistence. After examining the student characteristics and their reasons for choosing to participate in ECA, researchers look at persistence toward life goals as direct evidence of cognitive engagement, or the students’ thoughtful and intentional investment and intent to put forth effort, exerting effort on those activities considered of value. Examining data from Childhood And Beyond (CAB), Fredricks, Alfred-Liro, Hruda, Eccles, Patrick, and Ruan (2002) report that various factors (perceived competence, challenges and benefits, peer relationships, and emerging identity) contribute to adolescents' choice to remain involved in activities or quit. Working from a reverse perspective, Eccles, Barber, Stone, and Hunt (2003) report that dropping out of sports ECA seems to undermine attachment to school, increasing risk of depression and lower self-concept, especially for students who value sports, based on longitudinal data from the Michigan Study of Adolescent Life Transitions (MSALT) to study 1,259 10th-grade respondents from predominantly white middle-class families around Detroit. They find that 10th grade athletes who discontinue sport participation by 12th grade start lower and decline in the sports ability self-concepts while those who continue to play have higher sports ability self-concepts. While at first glance, increased ability would seem self-evident, the results show that there is also an identity-affirming role with continued ECA.

In addition, Eccles, Barber, Stone, and Hunt (2003) find those continuing in sports ECA until 12th grade had a broader range of non-familial adults and had more frequent conversations with them to discuss educational and occupational advice. In closing, they suggest more research on participant characteristics and the effect of persistence on psychological development. Hart (2005), using the 1979 Child in the National Longitudinal Survey of Youth (C-NLSY) data for approximately 1,000 participants over a ten-year period to examine moral identity, concludes that preadolescents who report weekly religious participation are almost twice as likely as those who never attend to be involved in community service four years later.

Cognitive Engagement: Benefi

The benefit and most highly reiterated aspect of cognitive engagement is the increased academic achievement for ECA participants. This aspect of cognitive engagement has been substantiated in numerous studies and for all ages (e.g., Darling, Caldwell, & Smith, 2005; Feldman & Matjasko, 2005; Gerber, 1996; Gifford & Dean, 1990). Starting with the youngest students (132 first graders in Toronto), Bower (2004) suggests that even for young first-graders ECA, such as chess lessons or science programs, may increase IQ. After studying four inner-city middle schools serving mostly economically disadvantaged, minority youth, Shann (2001) argues that the lack of ECA (77.2% of these students report no ECA participation) contributes to poor academic performance.

Camp (1990), studying secondary public school data from High School and Beyond (HSB, 1980) database, determines that student activity level has twice the effect size on achievement as that of study habits. Using a national sample of college-bound high school students, Everson and Millsap (2004) credit ECA participation for improving reasoning skills and SAT (Scholastic Achievement Test) scores, both verbal and math, even more so than for improving academic achievement. From their three-year study of thirty-five economically disadvantaged, ethnically diverse, academically talented urban high school students, Reis, Colbert, and Hebert (2005) conclude that ECA serve as protective factors that allow talented students to achieve at high levels. Mahoney, Cairns, and Farmer (2003) investigate ECA participation as a contributor to long-term educational success by assessing 695 male and female high school students in southeastern U.S. as seniors and later at age 20. Their study shows that consistent extracurricular activity participation is associated with positive changes in educational aspirations and interpersonal competence. Using the data from NELS (1988) for 4,382 eighth-grade girls, Chambers and Schreiber (2004) report that girls who participate in academically related school clubs and do more homework acquire higher levels of achievement. They postulate that these activities may be indicators of students that are already excelling in a particular area and are just continuing with their interests.

Cooper, Valentine, Nye, and Lindsay (1999), studying predominantly white secondary students in grades 6-12 and their parents from three Tennessee school districts, assert that after-school activities contribute significantly to the prediction of achievement, even after gender, grade level, ethnicity, free-lunch eligibility, and level of adult ECA supervision are statistically controlled. They acknowledge that they used a non-representative sample of students, considerably different from their target population, but justify that minorities and low socioeconomic families, as defined by eligibility for the free-lunch program, are already over-represented in the sample school districts (one urban, one suburban, and one rural) when compared to national statistics. They suggest caution when generalizing their findings to districts with different sample populations.

Contrary to those findings, Bell (2003) maintains that there are achievement differences to gender differences, based on the ways information is processed. He asserts that tests of declarative knowledge favor males and that giving tests of procedural knowledge would increase achievement by females. Achievement gaps are also based on differences in attitude and prior experiences. Males have prior experience with physics concepts, such as electrical circuits in ECAs. Furthermore, Bell (2003) attributes the performance difference on the United Kingdom examination given to 12,858 female and 12,774 male 16-year-olds to the very different leisure time activities of girls and boys, starting at early ages with toy choices and stories that focus on people versus objects.

Cognitive Engagement: A Summary

In summary, cognitive engagement in ECA deals with the deliberate, intentional choice of students to participate diligently and even beyond expectations, to master skills, to accept new challenges, and to persist toward life goals and values. Behavioral persistence indicates longevity of membership, but cognitive persistence means continuing to make the extra effort even beyond expectations to succeed and accomplish the tasks set before them. The characteristics of the students and the reasons they give for choosing to join ECA are indicative of their intentional intent to participate and persistence to life goals. With continued ECA participation, students also find an identity-affirming role as well as perceived challenges, competencies, improved peer interactions, and value added to their communities. The students' increased academic achievement validates their ardent cognitive engagement, although cognitive engagement also encompasses many life values that cannot be measured.

Emotional Engagement: Introduction

Emotional engagement in ECA deals with participants' positive and negative attitudes as well as the influences and reactions to teachers, parents, classmates, academics, and ties to the school or institution. Emotional engagement may be evidenced in: social communications processes, school spirit, sense of belonging, feelings, associations, cooperation, respect for others, warmth, empathy, humor, enjoyment, fun, ethical behavior, and integrity. Fredricks, Blumenfeld, and Paris (2004) clarify that many studies of emotional engagement do not make distinctions between positive emotions and high emotional involvement. Csikzentmihalyi (1999) uses the concept of 'flow' to qualify high emotional involvement as "a subjective state of complete involvement and concentration, whereby individuals are so involved in an activity that they lose awareness of time and space" (p. 821-825). The beneficial gains for students engaged in the 'flow' of ECA also reflect their emotional engagement.

Assessing and measuring the different forms of engagement necessitates different instrumentation. While behavioral engagement may be more readily apparent as evident in physical acts of being and doing, the other two forms offer more challenge. Some forms of cognitive engagement can be measured by achievement tests, but as shown in the previous section, mental determination and persistence to life goals and values can only be ascertained through direct conversation or by the actions they produce. While overt emotions and attitudes may be apparent, covert emotions may take considerable prodding to be revealed, let alone measured.

Emotional engagement for this study first examines the literature dealing with the influences of parents and teachers on students' participation and evidences of emotional engagement in ECA. The section on interactions with peers appears in more detail later in this study and the section on teachers includes studies addressing gender issues. The final sections elaborate on the benefits of emotional engagement, namely, increases in interpersonal skills, social networks and positive attitudes.

Emotional Engagement: Evidences

Influence of Parents. Emotional engagement comprises the reactions to significant adults, affecting the social ties and peer connections that students develop with their schools. The impact of parents on emotional engagement ranges from selection and support to value-added appraisals of ECA. Parents' influence extends from family values, social processes, aspirations, and giftedness and can be positive or negative.

Parents exert influence to transmit family values. Church activities offer ECA benefits that support emotional engagement, transmit family values, encourage persistent participation, and are very stable family activities, according to Olszewski-Kubilius and

Seon-Young (2004). Hanks and Eckland (1978), using longitudinal data from a national sample of adolescents surveyed in high school and again at age 30, suggest that participation in ECA is a pathway of transmitting parental values and cultural assets and this is why parents encourage participation. School, Parent, and Community Online Communications (2004) report on Steinberg's study of adolescents that encourages parents to attend their children's ECA to reinforce the home-school connection, but Baskin (2005) urges parents to balance children's ECA with family quality hours in the home and make decisions based on the children's age and maturity level in relation to the activities being considered. Feinstein (2001) in her personal autobiography and Olszewski-Kubilius and Seon-Young (2004) document supportive parents' efforts to influence and to add value to their lives. Shannon (2006), interviewing ten male and ten female local high school seniors involved in various ECA, as well as Swanson (2002) report that parents' efforts are designed to control resources in their children's ECA choices, insuring that the children will have functional challenges and competitive investments for college admissions. Shannon (2006) clarifies the purpose of ECA in that parents and students focus on the functional aspects of ECA (to give balance, to take a break from schoolwork, to reduce stress, etc.), rather than as opportunities for pleasure and enjoyment. Students in her investigation state that they do not tell parents about some activities because they *know* their parents would say "no," (school dances, etc.) These reports tend to support studies by Guest and Schneider (2003) and Swanson (2002) regarding ECA participation for resume-building purposes.

Emotional engagement also incorporates the social nature of ECA participation that is affected by parents. Using the longitudinal data from the Maryland Adolescent

Development in Context report to study 444 seventh grade students, equally representing African American and European Americans, both females and males, Jodl, Michael, Malanchuk, Eccles, and Sameroff (2001) highlight the potential role of parents as socializers of achievement-related values and the impact of parental values as positive predictors of adolescents' occupational aspirations. Based on responses from 63 10^{th} grade students, Schneider and Younger (1996) uncover that there is little correspondence between parent-child attachment and the positive aspects of adolescent social competence. Both positive and negative dimensions of parent-adolescent attachment are correlated with adolescent involvement in peer ECA.

Parental influence offers emotional encouragement for student aspirations as well as for social interactions. Hossler and Stage (1992) report that parental influence and educational level, not family income, is positively related to (and significantly higher for females) expectations for students, higher GPA, greater involvement in ECA, and student aspirations. Their results also show that parents of minority students have higher expectations despite the fact that minority students have lower GPAs in their study. Comparing responses of 850 high school students and 208 university students in Scotland, Reid and Skryabina (2002) find that despite previous poor experiences, students still choose to take physics, largely for social reasons, and that students and their parents are both aware in general of the value of physics for a career. They state that application-based courses, rather than lecture-based ones are very appealing to students.

Emotional encouragement from parents seems particularly relevant for gifted and talented students. Olszewski-Kubilius and Seon-Young (2004) discover that parents of gifted students are more involved in language arts activities and least involved in science-related activities, while students ask for more help with math (from their fathers) and language arts (from their mothers), but ask for very little help with science or computer science. Citing other studies, Cloud, Badowski, Rubiner, and Scully (2004) argue that parents should advocate that their gifted or accelerated children be advanced in school and conjecture that accelerated students are nearly as likely to participate in ECA as non-accelerants and will rate no differently on personal-adjustment scales. Although others report self-esteem declines for students the first time they are advanced into classes with their intellectual equals, Cloud, et al (2004) argue that the effect is usually small and temporary, and may be healthy for the often-outsize egos of highly talented students.

Studies have shown that emotional engagement may also be negatively impacted by parents, leading to less enthusiastic and less committed participation when it is in response to parental pressures and time management, rather than based on true student interests or motivation. Fisher (2005), reviewing the works of Missa Murry Eaton at Pennsylvania State University, cautions adults to not live their lives vicariously through their children, nor to push children into or control students in activities, but to guide them into ECA; rather empower their students to accept responsibility for their own choices, and reduce messages of parental anxiety. Fisher (2005) contends that parents who report their self-worth is highly contingent on the successes or failures of their children tend to be controlling and micromanaging children's lives, including activities, courses and jobs.

The benefits of ECA, specifically, improved student achievement, appear to be adversely affected with increasing perceived parental involvement according to a study of high school seniors responding to a Parental Involvement Scale by Mji and Mbinda (2005). Even more disturbing is the increasing parental pressure in upper socioeconomic status (SES) communities for high performance levels that students are developing stress-related symptoms, including depression and substance abuse. Based on self-reports from the New England Study of Suburban Youth (NESSY) with 314 students (150 girls and 164 boys) from two predominantly white affluent middle schools in New England, Luthar, Shoum, and Brown (2006) find that the “chronically critical parenting in high-income suburban communities can profoundly affect all children regardless of their families' material wealth” (p. 593).

Marsh (1992), using the large nationally representative High School and Beyond data, warns that ECA participation is being manipulated by school personnel as well as parents who exert their influence on student levels of participation. Similarly, Marilee Jones, Dean of Admissions at Massachusetts Institute of Technology (MIT) reports in her interview that college applicants are over-scheduled with activities designed just to keep students engaged while parents are not at home. As a result, MIT is now putting less importance on activities and more importance on personal attributes, by asking, “What Do You Do for Fun?” (2004, p. 110)

Influence of Teachers. In addition to the influence of parents, emotional engagement is comprised of the positive and negative reactions to significant adults related to the school culture, namely, teachers. As Brown (1988) suggests, these influences need to be examined within the broader social context. According to Van Matre, Valentine, and Cooper (2000), Jussim and Eccles (1992), and Rehberg and Schaefer (1973), teachers hold higher academic expectations for students involved in ECA than for students who work or are not involved in ECA; teacher expectations impact student achievement.

The emotional engagement of students based on teacher influence has been studied from several vantage points. Bidwell, Frank, and Quiroz (1997) describe workplace controls with respect to the impact they have on teacher-student relationships within schools. Evidence from their study of faculty members indicate that progressive teachers who stress higher-order thinking skills and intellectual independence for their students are better able to adapt effective teaching methods to emotionally engage their students. Crosnoe, Johnson, and Elder (2004) examined data for 14,966 students in 84 high schools from the National Longitudinal Study for Adolescent Health (NLSAH), a database that has fewer schools and less variation in school size than NELS or HSB, and find that increasing school size decreases teacher bonding and social interactions as well as ECA participation, thus, decreasing the emotional engagement of students. More specifically, Crosnoe, et al (2004) show that girls are less attached to their high schools but are closer to their teachers and are more likely to participate in ECA; school attachment and extracurricular participation decrease with age while student-teacher bonding increases with age. Dworkin, Larson, and Hansen's (2003) investigation of ten high school focus groups confirms that the "most effective adults in adolescents' lives are not over-directive, but rather are responsive and provide appropriate structure, challenge, and support" (p. 20).

Black (2004) using video and audio data collected over a five-month period of participant observation in a primary school mathematics classroom, shows how teacher expectations influence the quality of interactions and engagement that students experience in the classroom. Van Petegem, Aelterman, Roesseel, and Creemers (2007), investigating ninth grade students in technical and vocational training schools, learn that the students' perceptions of interpersonal teacher behaviors are crucial moderators of student well-being.

Impact of Gender. Emotional engagement as a reaction to teacher influence is repeatedly studied with respect to gender, albeit in the classroom as opposed to ECA. Kahle, Parker, Rennie, and Riley's (1993) study of 23 fourth and fifth grade teachers affirms that teacher expectations for girls and boys, the types of student-teacher interactions, and thus, student-student interactions have a gender effect associated with them. This gender effect is manifest when expectations, interactions or grades are related to student's gender, instead of ability.

Studying data from 4,495 males and 5,398 female adolescents in NELS: 90-92 survey, Hoffmann (2002) concludes that teachers definitely impact the instructional experiences and engagement of their students, stating that course syllabi and the modes of behavior of both male and female teachers are generally geared toward the interests, knowledge, and abilities of boys. Studying 3,446 5^{th} - 11^{th} grade students (1,723 female and 1,723 male), primarily Jews of North African origin from middle class homes attending coeducational public schools in Israel, Klein (2004) discovers that most of the variance in achievement was due to teacher gender; the influence of pupil gender was small. He maintains that all teachers give female students higher grades and that female teachers give higher grades than male teachers do. Sadker and Sadker (1993) insist that teachers can identify and improve their sexist practices in their classrooms by identifying the roots of gender bias and biased teaching tools, and by using specific equitable strategies in the classroom.

Based on the longitudinal data from the Michigan Study of Adolescent Life

Transitions, including 2,625 sixth grade students and 108 teachers in math classes in eleven southeast Michigan school districts, Jussim and Eccles (1992) maintain that teacher perceptions are generally consistent with stereotypes of gender differences, in that teachers rate boys as having more math talent than girls, but rate girls as trying harder than boys try, and thus, reward higher grades in math to girls than to boys.

Emotional Engagement: Benefits

Interpersonal Skills and Social Networks. Evidenced in social interactions, school spirit, feelings, attitudes, and ethical behavior, and influenced by significant adults, parents and teachers, emotional engagement in ECA offers several benefits for participants. One of the primary benefits for participation and emotional engagement in ECA is the development and refinement of interpersonal skills and social networks. As far back as the study of four coed mixed-level college classrooms by Dunkelberger (1935), a positive correlation shows that students who participate in activities have many interests, a "greater progressive spirit, and a richer social outlook" (p. 218) than those who do not participate. With multiple skills and affective dispositions as well as academic achievements essential for students to function successfully in today's society, Wanlass (2000) argues that "schools need to develop and recognize all these nonacademic talents so students can feel competent and experience success" (p. 513).

Positive Attitudes. The second major benefit of emotional engagement is the development and increase of positive attitudes. Using a secondary information database of students from six large diverse public high schools in California between 1987-1990, Darling, Caldwell, and Smith (2005) report that adolescents who participated in ECAs not only reported higher grades, but also more positive attitudes toward schools and higher academic aspirations once demographic characteristics and prior adjustment were controlled. According to Cushman's (2006) study of 65 urban high school students across the nation, ECA provide students with unique opportunities to apply collaboration, communication and outside perspective skills. Cushman (2006) also states that "clubs, especially those that do not entail competition, foster a tone of inclusion that often comes as a relief to students" (p. 37) and give students a vested interest in the affairs of their school, increasing engagement and building school spirit, as Dewey (1916) advocated.

Emotional Engagement: A Summary

In summary, emotional engagement in ECA fosters the development of interpersonal skills and social networks, promotes positive attitudes, spirit, feelings of belonging and success as well as creating vested interests in school. Parental influence on ECA participation is wide-ranging. Not only do parents' educational levels and socioeconomic status impact student ECA participation, but cultural values and vicarious perceptions also affect ECA involvement. Many parents may be imperceptibly manipulating ECA for time management or investment building for college, but ECA benefits may plummet based on the student perceptions of negative parental pressure or over-involvement. Most of the studies regarding teacher influence on and expectations for students deal with those interactions that take place inside the classroom versus outside the classroom in ECA. Few studies actually focus on the specific dynamics of these interactions. A large portion of these studies focus primarily on the issue of gender and student achievement. Few studies document the quality or types of encouragement given by teachers for students to join or engage in ECA. Emotional engagement is evidenced in school spirit, attitudes, emotional and social interactions, influenced by parents and teachers and fosters the development of interpersonal skills, social networks, and positive attitudes.

Limitations of Engagement in ECA Studies

Fredricks, Blumenfeld, and Paris (2004) point out how the use of the term *engagement* is frequently vague or all-encompassing without clear distinctions of its components. The terms *motivation* and *engagement* are sometimes used interchangeably in investigations while, in other studies, the concept of motivation is utilized in discussions on how to bolster flagging engagement. The use of the terms *effort* and *persistence* appearing as attributes of both behavioral and cognitive engagement also add to the confusion. Fredricks, et al (2004) recommend using behavioral *effort* as simply doing work and fulfilling expectations and using cognitive *effort* as focusing on learning and mastering concepts. This distinction in the terms will be used in this study. Similarly, behavioral *persistence* will be defined as longevity in ECA while cognitive *persistence* will be defined as sustained effort toward reaching a goal. The descriptors and evidences of the three engagement components as suggested by Fredricks et al (2004) will also be used in this study.

While these studies document ECA as offering behavioral, cognitive and emotional engagement for students, other studies question the validity of some claims and challenge the consistency of the benefits and engagement attributed to ECA. From his data analyses of the National Educational Longitudinal Study of 1988, Broh (2002) argues that participation in some ECA activities improves academic achievement, but participation in others diminishes achievement. Swanson (2002) cautions that there is a "point of diminishing returns associated with over-involvement" (p. 431), particularly those with progressively more competitive outcomes. Baker, Akiba, Le Tendre, and Wiseman (2001), using data from the Trends in International Mathematics and Science Study, term ECA as “shadow education” (p. 1) because the activities mimic formal education and show shadow education to be prevalent worldwide. They lament that ECA are generally remedial in nature and usually driven by institutional factors of education.

Many studies urge caution, resolution and challenge, suggesting limitations of these studies within four general categories, namely 1) qualifications of teachers or supervisors, 2) selective ECA participation, 3) school structure, and 4) social context.

Qualifications of ECA Sponsors. The first limitation deals with cautions regarding the qualifications of the ECA teacher/ supervisors. As far back as 1917, studies have expressed concerns over the supervision of ECA. After studying 13 large schools with approximately 1200 students each and 50 small schools with approximately 200 students enrolled, Wilds (1917) states that “these (associated) *evils* can be remedied by intelligent efforts at correct supervision” (p. 660) with one of the biggest problems being the inability to find teachers that are willing or capable of sponsoring such activities and the inability to compensate teachers for this extra work. He urges the implementation of a city-manager type plan with a supervisor of ECA, to insure the quality physical, social, moral and civic development of students.

Many researchers stress the importance, quality and support of supervising adults in classrooms and ECA if achievement and resilience are to occur (Crosnoe, Johnson, & Elder, 2004; Hirsch, 2005; Holloway, 2002; Jussim & Eccles, 1992; McLaughlin & Irby, 1994; Rehberg & Schaefer, 1973; Reis, Colbert, & Hebert, 2005; Reis & Diaz, 1999; Silliker & Quirk, 1997; and Van Matre, Valentine, & Cooper, 2000). According to Guest and Schneider (2003) and McNeal (1999), students' access to ECA is determined by internal factors such as teacher recruitment, safety and organizational constraints as well as the structure and context of ECA. Considering the influence of teachers on ECA, there are few studies that address the teacher attributes that specifically impact the emotional engagement of students in ECA. Silliker and Quirk (1997) suggest that a more systematic approach be taken in the education and preparation of these significant adults in the lives of students but there are no specific recommendations about how they should be trained or which qualities or behaviors that these adults should emulate.

While it is not the intent of this review to champion compensation, it is noted that few, if any, of the studies cited include any references to teacher compensation for services rendered, other than that of Wilds (1917). In a national survey of 1,737 public school systems with 1,094 districts responding, Educational Research Service (1989) documents that only 68% of the 578 districts that provided sufficient information compensate their teachers for sponsoring ECA. Kaser (1989) discusses the Department of Education Title IX Manual for the Education Amendments of 1972 regulations regarding the distribution of funds for equity in classrooms and ECA. According to Robertson (2001), ECA compensation may be changing, at least in Ontario, Canada, where provincial Bill 74, the Education Accountability Act, but also known as the "Teacher Indentured Servitude Act", requires more work from their teachers (e.g., sponsoring ECA) at the same time that the workforce is also being reduced. Studies focused on gender issues typically do not document the degree to which teachers' expectations reflect those of the corresponding communities or the difficulties encountered if teachers' expectations do not reflect those of the corresponding communities. These issues indirectly impact emotional engagement in ECA.

Highly structured, adult supervised ECA with opportunities for skill building, cognitive challenge, and positive social context are viewed as more beneficial than low structured, less supervised ECA (Broh, 2002; Chambers & Schreiber, 2004; Mahoney & Stattin, 2000; McLaughlin & Irby, 1994; and Posner & Vandell, 1999). After a longitudinal investigation of a representative cohort of 498 boys from a medium-sized community who participate in Swedish youth recreation centres, Mahoney, Stattin, and Magnusson (2001) reduce ECA benefits to negligible or inversely related if the activity has little structure and is located away from the school community. Their study indicates that youth centers in Sweden with low or absent structure yield higher criminal offense rates for males who participate in them. McNeal (1999) offers that a lower student-teacher ratio in ECA indicates that teachers are exerting more control, or making the club more academic rather than for leisure or interest. Broh (2002) urges further research to see if teacher leniency based on athletes' visibility and popularity with teachers accounts for the disparity between improvement in grades and improvement on tests for athletes.

Selective Participation. The second limitation involves some researchers challenging ECA studies because of selective participation. McNeal (1999), Morgan and Alwin (1980), Ostro (2006), and Pipho (1986) criticize ECA participation as being limited due to selective criteria, including 1) activities with entry-level requirements, such as GPA, competitive try-outs, or limited enrollments; and 2) students who join ECA are already more attuned to adult values, such as academic achievement and educational aspirations, altering the significance of ECA benefits. After studying 10,613 students who attended the same high school in their sophomore and senior years from the national

High School and Beyond (HSB) database, Marsh (1992) suggests that ECA participants are more motivated, interested and invested in schools, and this increases their academic performance, findings echoing those of Herman (1997), while contradicting those of Hunt (2005). Darling, Caldwell, and Smith (2005) counter that it is the participation in the activity that develops these values and aspirations in the students, not the beliefs held prior to participation.

Broh (1990) poses the challenge that research is needed to determine if students who are faced with the withdrawal of the "*privilege* of participating in ECA are actually motivated to improve their academic performances" (p. 278). While agreeing that ECA produces a number of positive consequences that carry over into adult life, namely, people's participation in political activities in adulthood, Hanks (1981) examining data from 10,245 black and white high school seniors from the 1972 National Longitudinal Study (NLS), decries the excessive manipulation of ECA by school officials and community leaders.

Few, if any, of the studies encountered thus far have addressed the costs involved in belonging to a club or ECA as restricting students from joining an ECA. Costs such as uniforms, equipment, and travel may be school-supported for more prestigious clubs or sports teams, but not all ECA. If students are unable to pay the costs, this also limits or prevents participation.

School Size. A third limitation involves school size, structure, organization and context. These factors influence not only student achievement and engagement, but also challenge the benefits of ECA (Baker, Akiba, Le Tendre, & Wiseman, 2001; Bidwell, Frank, & Quiroz, 1997; Crosnoe, Johnson, & Elder, 2004; Everson & Millsap, 2004;

Guest & Schneider, 2003; Hoffman, 2006; Holland & Andre, 1987; Lindsay, 1984; Mahoney & Stattin, 2000; McNeal, 1999; and Morgan & Alwin, 1980). Crosnoe, Johnson, and Elder (2004) equate increasing school size with decreasing rates in student attachment to school, bonding with teachers, ECA participation as well as interpersonal dynamics across student groups. Bidwell, Frank, and Quiroz (1997) cite that the school workplace and its control systems impact the way teachers conduct their work and their attitudes after examining the faculty social organization of 13 public and private, large and small high schools in Chicago.

After examining the data of 30 small schools in the state of Washington collected by Slocum and Associates, Morgan and Alwin (1980) maintain school size drastically affects ECA participation, citing ECA's centrality (expendability during increased budget cuts) and elasticity (capacity to absorb more participants) for continued existence. Bidwell, Frank, and Quiroz (1997) cite the need for teacher and parental decision-making power in schools to support various ECA.

Social Contexts. In addition to the three limitations already cited, a fourth limitation deals with the social contexts that challenge ECA benefits. In a similar manner to Hoffman (2006), Guest and Schneider (2003) maintain that social context determines the value of sports, defining social context as the meanings and value systems that the local community applies to interpret the interactions and relationships of its participants. In alignment with the findings of Eder and Parker (1987), they purport that athletes are more likely to be considered good students in poor communities and students involved in non-sports ECA will more likely be seen as good students in socially mobile and wealthy communities. Crosnoe, Elder, and Johnson (2004), like Morgan and Alwin (1980), report that with increasing school size, ECA without flexibility and elasticity to allow for increased participation actually decrease the benefits expected.

Guest and Schneider (2003) further challenge that 1) the type of participation or activity influences its social values, identity types, and developmental outcomes; 2) participation in ECA cannot be assumed to have uniform positive effects for all individuals; and 3) formal and informal activity settings have different influences on motivation and perceived competencies. Posner and Vandell (1999) and Chambers and Schreiber (2004) report similar findings for low-structured, informal ECA settings. Using NELS:88 data file respondents over a ten-year period, Regnier and Planty (2003) caution that participants required to perform volunteer service in ECA are less likely to volunteer in later years than those who perform volunteer service for other reasons.

Social context also includes the parent influence on the emotional engagement of students. Parental influence is more often documented for school and academic achievement endeavors than for ECA, but the impact may well be the same. Studies discuss parental influence with respect to family values, socialization processes and career aspirations. They also raise cautions about the excess and abuse of parental and institutional influence to a point that is detrimental to the health and well-being of students. In a study of 737 public high school students (ages 15-18) and their parents in Cyprus (all Greek residents), Koutsoulis and Campbell (2001) suggest that parents use high pressure and low support to make their students more serious and dedicated. They recommend “opening better lines of communication between parents and teachers” (p. 124). Hossler and Stage (1992) say that there is not enough research on the formation and development of educational aspirations and recommend that efforts to “influence post-secondary aspirations be targeted at both students *and* their parents" (p. 446).

Research is still unclear in the area of family influences. Some studies allude to parenting styles and the relationships within the family, the sibling relations, and particularly, the impact of the sibling order. Studies do not always include emotional engagement due to changes in family structure - deaths in the family, divorce, merging families or relatives. One study (Jodl, Michael, Malanchuk, Eccles, and Sameroff, 2001) even excludes students from the survey unless their parents are non-divorced. While the assumption may be that both parents are working outside of the home, there appears to be little clarification of the home environment schedules, of stay-at-home-moms versus working mothers, mothers working part-time versus mothers working nine-to-five, or other variations of work-home times. Studies of parental influence are difficult to find with respect to parents as role models, or as homeschoolers, and the emotional engagement these roles foster.

A Summary of Engagement in ECA Studies

These studies document the behavioral, cognitive and emotional engagement of students in ECA. Studies support that ECA provide positive student gains in psychological development, academic adjustment, healthy lifestyles with fewer problem behaviors, interpersonal skills and social networks, and especially academic achievement. Characteristics of typical participants and their reasons for belonging to ECA are identified, although "just for fun" or "my parents made me" are not listed as reasons for ECA participation. Research shows that these gains from ECA are especially significant for low-income, urban, high-risk or disadvantaged children or those underserved in regular school environmental constraints.

Limitations to the applications and conclusions of these studies center upon four general issues, namely, qualifications of teacher-supervisors, selective participation, school size and structure, and finally, social context, particularly, with respect to socioeconomic status and parental educational levels. School size dramatically alters the availability and continuity of ECA and participation.

Additional research is needed to study the specific qualifications and impact of teachers or adult supervisors on the benefits of ECA. Perhaps, teachers sponsoring ECA activities generally have better attitudes and beliefs in students and/or have better job satisfaction. Studies are needed to establish how the teacher's attitude and beliefs impact student ECA participation and learning, and how the teacher's job satisfaction impacts ECA benefits. The impact of the implied practice of forced sponsorship on effective student participation and engagement in ECA may have serious, far-ranging consequences. A comparison of years of teaching experience versus sponsorship of ECA is coming under scrutiny by Burian-Fitzgerald and Harris (2004) for the workweek expectations of Michigan teachers, citing that younger, less experienced teachers are asked to sponsor more and more ECA at a time when they need additional preparation time for their relatively new instructional responsibilities. Further studies are also indicated to clarify the impact of a student's own classroom teacher being the student's ECA sponsor as opposed to an unknown classroom teacher being the student's ECA sponsor, and the impact of a classroom teacher vs. an outside, highly qualified expert as the ECA sponsor.

Further research is needed to delineate the benefits for participation in ECA based on the types of engagement, amount of time spent, occurrence during the school year, leadership opportunities available, structure and rules, group interaction and connectivity, and longevity of membership in the ECA. Future research must more precisely establish conceptual frameworks and focus on the processes of influence within the broader social context in the lives of students.

Engagement in Science ECA

While there are exhaustive studies on ECA, there are comparatively fewer studies done regarding engagement in extracurricular science activities, and involving considerably fewer participants, according to the number of students the studies have surveyed and the greater variety of countries in the studies cited. Research in science tends to focus on or relate to science fairs (a class requirement rather than a voluntary ECA) or classroom experiences, rather than on science ECA. Studies of science ECA lack the breadth or depth of the topics covered in studies of general, non-science ECA. Comparisons of findings are not always possible between these two types of ECA.

Most science ECA involve students doing independent science research. In general, those activities are highly competitive in nature, organized by large corporations and offered nation-wide. Many competitions are one-time affairs with no intermediate steps at the local, district, or state levels for evaluations or opportunities for improvements. These individual efforts may be school sponsored, albeit not supported with school spirit or funding for materials, supplies or transportation to distant competitions. These challenging activities include, but are not limited to: Intel (formerly Westinghouse) Science Talent Search, Toyota Science Contest, National Science Olympiad, Toshiba's Exploravision: Tomorrow's Technology, Duracell Contest, JETS

(Junior Engineering Technical Society), TEAMS (Tests of Engineering Aptitude, Math and Science), FIRST (For Inspiration and Recognition of Science and Technology) and ISEF (International Science and Engineering Fair) with its preliminary local science fairs.

Behavioral Engagement in Science ECA

Sponsors or others working with students in these competitions readily attest to the behavioral engagement of students who enter these highly competitive contests, in that they put in the time necessary to finish the project. Olszewski-Kubilius and Seon-Young (2004) find that boys participate more in science, science-related, and academic clubs than girls do.

Science fair competitions dominate science ECA opportunities. From a content analysis of 1,319 project topics submitted to the Northeastern Indiana Regional Science and Engineering Fairs from 1991-1993, when girls do participate in science fairs, Lawton and Bordens (1995) document that girls are more likely than boys to enter science fair projects on biology and personal science experiences than projects on electricity and physical science topics, a trend increasingly evident with student age. Similar results are reported by Debacker and Nelson (2000) in their investigation of 242 high school students in two suburban public high schools in a university town in the mid-south. In a like manner, Jones (1991) studying North Carolina student participation data for the years 1987-88, finds that gender difference in science competitions reflect gender differences in course selections and career choices. Wilson, Cordry, and Uline (2004) urge that simply increasing student participation in science fair projects of their own interests will increase student engagement in the science classroom. Contrary to these findings, Reid and Skryabina (2002), after studying over 850 students aged 10-20 years in Scotland, argue that good classroom experiences, committed teaching force, and the perceived value of physics, rather than any outside school activities, attract more students to physics.

There are other science ECA opportunities, but in poor contrast to the numerous non-science ECA possibilities. These few other science ECA are all unique sponsor- and site-specific. Hill and Taylor (1992) report successful integration of a history and science club that offers hands-on science activities. O'Neill and Barton (2005) report increased ownership and connectedness to school and science with their informal science video project with two groups of five sixth graders in an urban, minority school in New York City. Voegel, Quashnock, and Heil (2004) describe an activity of high school students under the direction of their teacher performing chemistry demonstrations at local elementary schools. Bonnstetter (1985), Kisiel (2006), Kralina (1989), McKinstry (1988), Paris, Yambor, and Packard (1998), Schneiderman (1973), and Wiper (1973) report on other unique science ECA clubs.

Cognitive Engagement in Science ECA

Cognitive engagement of students in science ECA has also been examined. Using Michigan CAB data for the same 227 students over a seven-year period, Simpkins, Davis-Kean, and Eccles (2006) determine that math and science ECA participation are good predictors of future math and science course enrollments. Using data from nearly one million ACT-tested students in the high school graduating class of 1998, McLure and McLure (2000) report that regardless of gender, race, or socio-economic status, students with out-of-class science accomplishments tend to earn higher ACT Science Reasoning scores than do those students without them. Contrary to this finding, Zuzovsky, Chen, and Tamir (1990), using test data from 1,305 Israeli fifth graders involved in the Second

International Science Study, assert that most of the scientific knowledge that children master within school is the same as that which they master in out-of-school activities. Several of the following studies regarding cognitive engagement are more gender-specific. Evidence of cognitive engagement in science ECA is examined in terms of participant characteristics, reasons given for joining and persistence to goals. Academic achievement is examined as the major benefit of cognitive engagement.

Day, Langbort, and Skolnick (1982) in *How to Encourage Girls in Math and Science* analyze research data and isolate spatial visualization skills as the major stumbling block for girls' achievement in science. Addressing spatial visualization skills within science lessons will help girls better understand abstract concepts. Quaiser-Pohl and Lehmann (2002) in their study of 112 female and 71 male British undergraduate students, agree that, “compared to males, females' spatial abilities are extremely weak and easily modified by attitudinal and experiential factors” (p. 245). Based on their study of 181 students in five 10th grade classes in Israel, Huppert, Lomask, and Lazarowitz (2002) advocate the use of computer simulations to improve spatial reasoning skills, science process skills, and academic achievement for all students.

Reasons for Joining. Cognitive engagement can be evidenced in the reasons that students give for participating in science ECA. Studying 147 junior high school students attending the Weizmann Institute of Science in Israel, Eylon, Hofstein, Maoz, and Rishpon (1985) stress that high-ability students thrive on the theoretical and experimental independent study offered in these extracurricular science programs. Participation by 544 10th grade students in Israel in informal and formal science activities demonstrate a commitment to science and science learning, according to Tamir (1990-91), who suggests that school conditions, home influences and career aspirations appear to guide decisions to participate in such activities.

Investigating why students participate in science competitions (state science fair and state Science Olympiad contests in Utah), Abernathy and Vineyard (2001) report that 490 high school and junior high school female and male students cite primarily course requirements, strong teacher coercion, and parental intervention. These reasons are far different than those cited for non-science ECA participation, as reported by Olszewski-Kubilius and Seon-Young (2004). 'Just for fun' is still not listed, although 'My parents made me' is a reason given for joining science ECA noted here, even for the gifted and talented students in Eylon, et al (1985) study. Baker and Leary (1995) in their interviews with forty girls in grades 2, 5, 8, and 11 report that girls who choose science careers are attracted to them because of "strong affective experiences with a loved one and a desire to help" (p. 176). Several of the reasons given why students participate in some ECA are affected by parental influences, verifying the cognitive engagement due to parents for some students in science ECA.

Academic Achievement. The major benefit of cognitive engagement is academic achievement. Many empirical studies done in the 1980's (Day, Langbort, & Skolnick, 1982; Handel, 1986; Kahle & Lakes, 1983; and Kahle, Matyas, & Cho, 1985) document girls' lower achievement than boys in science courses. More recent studies by Abernathy and Vineyard (2001), Bacharach, Baumeister, and Furr (2003), Campbell and Clewell (1999), Chinn and Iding (1997), Haussler and Hoffmann (2002), Lawton and Borders (1995), Munro and Elsom (2000), and Yasar and Baker (2003) continue to corroborate the lower achievement of girls than boys in science. In reviewing a decade of gender equity projects in science, technology, engineering, and mathematics (STEM) fields, Dyer (2004) finds that special programs to boost achievement by girls still confirm the girls' lower achievement in science than that of boys.

Jacobs, Finken, Griffin, and Wright (1998) maintain that science ECA in a rural environment are necessary to maintain girls' interests in science, based on their study of 220 high school rural female students who are talented in science. In a study of 900 students in rural communities in SW England, Gillibrand, Robinson, Brawn, and Osborn (1999) find girls in single-sexed science classes enjoy greater confidence and achievement than those in mixed classes.

Emotional Engagement in Science ECA

Most research on emotional engagement deals with science coursework, rather than with science ECA, but the strong trends noted similarly impact the students' emotional engagement in science ECA. Hofstein, Maoz, and Rishpon (1990) find that junior high school and high school students exposed to extracurricular science activities have more positive attitudes toward school science. Studying 88 gifted students from 38 high schools, Stake and Mares (2005) state that students report significant gains in motivation and self-confidence after participating in a summer science-enrichment program held at a college campus. Jacobs, Finken, Griffin, and Wright (1998) in the United States and Miller, Lietz, and Kotte (2002) in the UK and Australia find that an active intrinsic interest in science is strongly related to a preference for a science career. However, after reviewing 177 sources of national and international research literature about girls' participation in physics, Murphy and Whitelegg (2006) conclude that "interest and enjoyment in physics influence course choices, particularly for girls, and these attitudes decline through schooling, more so for girls than boys” (p. 281).

Impact of Gender. Researchers also cite gender issues as impacting the emotional engagement of female students in science. Schools perpetuate social and cultural stereotypes (Lupart, Cannon, & Telfer, 2004) by offering few role models of women scientists (Cushman, 2006), and by channeling girls into fewer math and science courses that subsequently limits their options for feasible career choices (Debacker & Nelson, 2000). Cereijo, Tyler-Wood, and Young (2002) report on BUGS (Bringing Up Girls in Science), a science club for girls in fourth and fifth grades designed to increase girls' interest, participation, self-concept, knowledge, and achievement in the environmental sciences and in technology.

If girls perceive science as a more valuable asset in relation to their daily lives and can use it to help others, they will view science as a more viable option for study and career choice, according to Baker and Leary (1995). Based on 11,683 students in the national HSB database, Hanson and Kraus (1998) state that participation in sports ECA has a positive influence on achievement in science for girls, although a negative influence on science achievement for African-American girls and males. Kerr and Robinson-Kurpius (2004) report that their values-based career intervention ECA, TARGETS improves the career attitudes, beliefs and aspirations in math and science as well as self-concepts for the 502 girls from 45 different high schools across Arizona who participated during a seven-year period.

Influence of Parents. Emotional engagement studies have already documented the impact of parents on students’ ECA participation. In a similar manner, studies of science ECA regarding family involvement show that parents exert considerable influence in their students' decisions, although some studies seem contradictory. Lawton and Borders (1995) report that parents are not a distinguishing factor in student choices of topics, while Chinn and Iding (1997) in conducting surveys of predominantly Asian female students in college preparatory chemistry classes, find that family and science ECA are powerful influences. Parental cultural values may also be indicated by these contradictory findings.

Based on surveys of former participants in a high school enrichment program for girls interested in science, administered one to two years after high school graduation, Scott and Mallinckrodt (2005) contend that science self-efficacy is negatively associated with recollections of fathers who have a highly controlling parenting style and are likely to exert pressure through a love withdrawal. Yet the absence of a father figure is equally damaging, according to Davis-Maye (2004) in her study of 866 African-American girls, aged 9–19, residing in two southern Alabama cities. She finds that girls need at least low levels of support from their paternal figures in order to positively impact their level of hope for the future. Davis-Maye (2004) defines hope as reflecting a person's "belief in her ability to achieve certain goals, thus affecting academic achievement, healthy emotional development, and successful transition to adulthood" (p. 53).

The wide range of parental support and intervention in these studies is also evident in the following gender-specific studies. Simpkins, Davis-Kean, and Eccles (2006) suggest that ECA choices are impacted by "cultural expectations and with parent education having an early impact on girls and a later impact on boys" (p. 79). Jodl, Michael, Malachuk, Eccles, and Sameroff (2001) find that adolescents' occupational aspirations are impacted, both directly and indirectly by parental values for African

American and European American males and females. Koutsoulis and Campbell (2001) find that parental pressure is a negative predictor of motivation and math/science achievement, especially for girls. Although their study does involve more girls than boys (445 girls and 292 boys), it is representative of the general population since more Greek boys attend technical high schools.

Influence of Teachers. Emotional engagement in science ECA also is also influenced by the interactions with teachers. Empirical studies, such as that of Munro and Elsom (2000) show that science teachers are very influential in students' interest and pursuit of science-related careers. Researching the impact of TIP, a Teacher Intervention Program, Mason and Kahle (1989) report that female students taught by highly trained teachers have higher scores on tests of attitudes toward science, perceptions of science, and science experience. Based on a study of 141 female and 129 male high school students, Stake and Granger (1978) find that teacher attractiveness and science-related teacher contact affects the influence of same-sex teachers more than that of opposite-sex teachers. Klein (2004) attributes teacher gender as the factor explaining gender achievement gaps, particularly with respect to class size, reporting that female teachers grade harder on larger classes than male teachers. Surveying teaching strategies and teacher attitudes of 205 females and 147 males from seven high schools, Kahle (1983) shows that teachers who successfully encourage girls in science

> Maintain well-equipped, organized, and perceptually stimulating classrooms, are supported in their teaching activities by parents of their students, are respected by current and former students, use non-sexist language and examples, include information on women scientists, use a variety of instructional strategies, stress creativity and basic skills, and provide career information (p. 1).

Girls want more small-group, hands-on science activities to reinforce ideas

(Campbell & Clewell, 1999; Kahle & Meece, 1994; Murphy & Whitelegg, 2006; and Stohr-Hunt, 1996). Murphy and Whitelegg (2006) further assert that teachers must make sure that girls take an active part in science classes due to boys' tendency to be more assertive. Koszalka, Grabowski, and Darling (2005) report increased levels of science career interest with classroom use of web and human resources, especially for females. They also suggest that science career interest is dependent on the teacher’s knowledge of science and the degree of student-centered instructional strategies used in the classroom.

Hammrich, Richardson, and Livingston (2000) conducted a three-year study of fourth and fifth grade students, collecting teacher reflections and dialogue concerning the students’ conception changes to equitable science and mathematics teaching practice. Hammrich, et al (2000) stress the importance of teachers as change agents for gender equity and as decision-makers in promoting science literacy for all students. To give girls a better chance in science, Hoffmann (2002) recommends that teachers 1) develop units and materials based on the specific interests and experiences of girls, 2) implement more equitable instructional strategies, and 3) teach single-sex classes. After a study of over sixty one-hour lessons and twelve experimental and seven control classes of seventh graders (age ~13), Haussler and Hoffmann (2002) make vital recommendations to teachers to increase the engagement of girls in science. They report:

> Curricular changes with respect to girls’ interests and experiences, classroom organizational changes, as well as improvement in the teachers’ ability to support girls to developing a positive physics-related self-concept result in higher achievement, perceived competence, and interest in physics, increasing their engagement (p. 870).

Howes (2002) in her book *Connecting Girls and Science*, maintains that if teachers incorporate topics of interest to girls, girls will learn to love science and barriers that keep girls from pursuing science careers will disappear. Kennedy and Parks (2001) offer several recommendations, stressing that a “feminist scientific environment is needed, one that respects all students and that teaches to individual strengths” (p. 534). Gilbert (2001) in New Zealand, more emphatically challenges teachers to “design school science programs that allow young women to participate in science as women, rather than as ‘substitute’ men” (p. 291).

Gender bias affects the self-concept of adolescent girls and verifies their adherence to cultural norms and stereotypes. Kahle (1983) after a 9-month project that included 205 females and 147 males from seven high schools using a variety of instruments to assess attitudinal, cognitive, and socio-cultural variables, notes that:

> Girls have poorer attitudes toward science, enroll less often in science courses, demonstrate lower achievement levels in science, and have fewer experiences with science materials or instruments. Among the factors identified as contributing to the dearth of girls and women in science courses and careers are social factors (role models, sex role stereotyping), educational factors (enrollment patterns, parent/teacher expectations, classroom and extra-curricular activities), and personal factors (spatial visualization). Briefly, the effect of sex role stereotyping of physical science courses and careers as masculine deters entrance by, and retention of, adolescent girls. Furthermore, the lack of female role models has a negative effect, particularly on early adolescent girls. In addition, girls have fewer opportunities to develop spatial visualization skills, which may be an important factor in science achievement. Bruer (1993) cites that “mental representations are fundamental in constructing knowledge and providing links between external environments and mental models” (p. 22-3). However, the most critical difference occurs within science classrooms. Research shows that girls have fewer experiences with science instruments, materials, or techniques. This difference must be addressed by every science teacher to eliminate inequalities in science education (p. 2).

Kahle, Matyas, and Cho (1985) also suggest that even if girls have equal experiences within science classrooms, these experiences do not help girls overcome the advantages boys have because more extracurricular science activities are available to them. Based on data obtained from 242 seventh and eighth grade students, Handel (1986), in like manner, ascribes extracurricular mathematics, science, or computer activities as the best available indicator of socialization. She maintains that improving girls' self-concept will give them the self-efficacy to accept new challenges and be prepared to take more risks. Suggestions for enhancing science classroom equity are equally valuable for increasing female interests in science ECA.

Limitations of Engagement in Science ECA Studies

While science competitions and student research opportunities are excellent ECA options and reinforcements for select students already enthralled with science, or geniuses (Markowitz, 2004; Watson, 2004), they do little to promote the interest and passion for science in the vast majority of more casual, exploratory-stage students. There is a large gap between these predominant, overpowering types of competitions and the sparse science ECA that involve less competitive, more collaborative, informal and locally-supported science explorations, such as those reported by Bonnstetter (1985); Crawley (1998); Hill and Taylor (1992); Kisiel (2006); Korpan, Bisanz, Bisanz, Boehme, and Lynch (1997); Kralina (1989); McKinstry (1988); Paris, Yambor, and Packard (1998), Schneiderman (1973); Silver (1994); Voegel, Quashnock, and Heil (2004); and Wiper (1973). Dyer (2004) faults the lack of integration of effective, valuable science ECA (2/3 of all projects) into school curriculum that is preventing gender equity in teaching and learning in STEM fields.

While teachers may hope for transference of both scientific knowledge and inquiry skills in science ECA, Sumrall and Schillinger (2004), Watson (2003), and Yasar and Baker (2003) are unable to find any significant gains in scientific method knowledge or attitude toward science when students are required to produce science fair projects. Interviewing one high school teacher who only employs voluntary science fair projects, one parent, and one school library media specialist, Watson (2003) states that the linear model enforced in the process is not construed in such a way as to be *sense-making* for the students, and that this is not the way real scientists work. Watson (2003) also questions why many teachers and schools choose to forego in-depth project work in the face of standardized test preparations and ponders whether school programs can even accommodate genuine inquiry. Sumrall and Schillinger (2004) declare that participation in the science fair itself does not necessarily translate into a student's attainment of such skills because project quality and a student's successful achievement of good inquiry skills vary greatly from fair to fair. They caution that “participation in a science fair should not be viewed as the ‘one shot’ opportunity for teachers to involve their students in inquiry” (p. 22).

Yasar and Baker (2003), studying 859 seventh graders from six schools, find no significant gains in scientific method knowledge or attitude toward science, even when students voluntarily produce science fair projects. Sorge, Newsom, and Hagerty (2000), studying predominantly Hispanic middle-school students participating in New Mexico MESA (Math, Engineering, and Science Achievement), a space science program at the University of New Mexico, find that although students display significantly more positive attitudes toward science and scientists, they still have difficulty imagining themselves as scientists. Painter, Tretter, Jones, and Kubasko (2006) report on a program that first had to change students’ misperceptions that all scientists are male, wear white lab coats, only do experiments and especially, that they are weird, boring and work alone in order to stimulate their interest in science-related careers. Chinn and Iding (1997) state that students' views of themselves as scientists and writers of science are related to gender, citing family and science ECA as powerful influences. Reviewing 35 articles on science fairs, Slisz (1989) documents that publications occasionally print accounts of successful science fairs, but these articles are usually based on opinions, rather than on research. Failing to realize the connection with inquiry and science curriculum, Slisz (1989) then recommends that better quality projects will result if students complete them outside of the science classroom.

While failing to address the highly competitive nature of extracurricular science activities, the disparate gender participation, or the overall low participation in science versus other academic ECA, Colwell (2005) urges more comprehensive judging in science fairs to “close the gap between a given project and what the real world of science would require” (p. 12). Slisz (1989) suggests that clearer guidelines (more structure) will increase student participation in science fairs and Chinouth (1994) simply offers less expensive ideas for science fair projects. None of these studies, however, offer supporting research or address how to motivate less-qualified or less-interested students to choose to do science fair projects voluntarily, but only recommend more stringent rules or guidelines to apply when students do attempt a project.

Investigating three teachers’ classrooms over a two-year timeframe for effective implementation of a “little scientists” approach (p. 241), O’Neill and Polman (2004) urge educators to allow students to actually do the work of scientists, rather than refining techniques to master concepts, and to give students ownership of the investigations from start to finish. Their project-oriented approaches can be traced back to the philosophy of

John Dewey (1916), that is, people learn best by doing.

A Summary of Engagement in Science ECA Studies

Science ECA are typically individualistic, highly competitive and are offered nationwide. Successful engagement of students in science ECA appears focused but limited, compared to non-science ECA. Course requirements, teacher coercion, and parental intervention are cited as reasons for participating in science fairs and competitions, in stark contrast to the reasons given by students for participating in non-science ECA. The limited and questionable benefits of science fairs and competitions are also in direct contrast to the positive results cited by several individuals regarding local, non-competitive science ECA clubs. Studies question whether students are really learning the scientific method in contrived situations along linear investigative models and suggest that students learn science best with hands-on approaches, or by 'doing' science. Perhaps, science should actually be considered a verb, and children should be 'sciencing'.

While the limitations to student engagement in science ECA are lamented in many studies, several offer helpful suggestions. Abernathy and Vineyard (2001) suggest that teachers may want to consider promoting other types of science activities, such as service-learning projects or community service as other opportunities for students to participate in science, therefore encouraging more and different types of students to participate. Summarizing other reviews, Talbott (1997) urges greater use of hands-on science as a means to engage and motivate students in diverse social and academic settings. This also prepares students to pay attention to social cues in their environment, suppressing some antisocial behavior. Silver (1994) suggests converting science fairs into a cooperative Science Expo. Munro and Elsom (2000) stress the importance of having concerned, qualified science teachers for these extracurricular science activities, based on their survey of 155 career advisers in seven careers service companies to juniors in six United Kingdom high schools. Day, Langbort, and Skolnick (1982) in *How to Encourage Girls in Math and Science* analyze research data and find that girls have better communication skills than boys. Girls do well in transactive discourse, according to Berkowitz and Simmons (2003). Some science fair activities incorporate defense of the project before a panel of judges and the potential for girls to improve science understanding through this discourse requirement is another potential area of study.

The differences noted in the studies indicate a need for extensive research regarding the gender disparities and to provide recommendations on how to better serve, encourage and engage more students, particularly females, in science ECA. In reviewing various ECA studies, Holloway (2002), Project Director for Educational Testing Service of Princeton, NJ stresses that ECA could and should appeal to student interests, encourage peer interaction, prompt cooperation, build student-adult relationships, provide structure and challenge, and draw students, especially minorities and women to science. More hands-on approaches are needed in science ECA and future studies will hopefully find that science ECA utilizing these approaches are more engaging for a greater number of students, offering increased student enjoyment, and further enhancing science learning than the majority of the science ECA currently available to students.

The Chasm in ECA Studies

This concludes the review of the studies dealing with engagement. However, a review of the literature indicates a wide chasm between those ECA studies that deal with engagement and those ECA studies that deal with identity formation. This study seeks to bridge the gap between engagement studies and identity formation studies by gleaning and merging the rich insights from both realms of investigations. By addressing how students behave, think and feel from both engagement and identity formation perspectives, a more comprehensive theoretical framework for an engaging and socially constructive science ECA can be designed.

Identity Formation and ECA

Aside from providing successfully engaging ECA, schools are challenged to develop and prepare their students to be engaged, informed and productive citizens of the future. This study also examines how ECA opportunities allow students to clarify and refine their identities as well as to 'position' themselves into different potential trajectories of identification. The evolution of this identity formation may be envisioned as a journey of discovery through time and circumstances. An individual experiences social 'positioning' first by parents, teachers, and especially by peers. New experiences reveal new talents, develop latent ones, facilitate new positions, and foster new and different future possible trajectories of identification toward an adult identity. This conceptual process is examined in more detail in three sections – initial identity formation and self-concept, social positioning and trajectories of identification, and finally, the role of education in changing positions and boundaries.

Identity Formation and Self-Concept

Initial Formation. The first phase deals with the initial identity formation and self-concept process. This process includes the transmission of cultural values, connectedness, psychological adjustments and personality trait development. Waterman (1984) states that identity is not developed through internal psychological processes, but rather through participation in activities that allow individuals to discover their true self. Hart (2005) states that identity refers to the various experiences associated with the self, including self-awareness and continuity through time and context. A youth's identity is discovered through the identification of talents and abilities when participating in and reflecting on activities that allow students to try new things and learn about themselves in the process of this identity work, according to Eccles, Barber, Stone, and Hunt (2003). They assert that the choices of such activities, particularly school ECA, are critical in providing shared experiences as well as opportunities to explore a wide range of options while maintaining social value and relationships with peers and adults with mutual interests and goals. Dworkin, Larson, and Hansen (2003) also cite the development of initiative, emotional self-regulation, peer relationships, understanding others, teamwork, and social skills as identity work or formation.

Cultural Values. Identity is formed along a differential continuum of cultural values with corresponding educational achievement and aspirations, according to studies by Kao (2000) and Lupart, Cannon, and Telfer (2004). Based on their study of 1,419 high school students with the Eccles Model of Achievement Related Choices, Lupart, Cannon, and Telfer (2004) confirm that gender and age are the basis for stereotypical course selection and future career aspirations with males selecting science and information technology related courses and careers, and girls selecting English/language arts courses and artistic or health professions. Interviewing 63 students from a multi-racial public high school in Chicago, Kao's (2000) study asserts that adolescents frequently define their goals in terms of popular group images or stereotypes that link innate abilities or behaviors to race or ethnicity. These images tend to maintain racially and ethnically segregated norms of behavior, specify areas of expertise within social and academic life, and reinforce racially and ethnically segregated ECA and peer groups. Socializing among the same-race peers also promote comparable images of success within ethnic groups. Specifically, Kao (2000) finds that

> Black youth focus on avoiding failure, Hispanics focus on avoiding manual labor and hope for office work (avoiding failure rather than promoting academic behaviors), while Asians focus on high achievement in math and science and the academic image of any ECA before joining (avoiding failure but with major pressure for success) (p. 409).

Kao's (2000) study concludes that these group norms define "expertise, maintain racial and ethnic boundaries, and shape expectation levels for students, which ultimately affect student success" (p. 429). These findings may give impetus to the old sayings, birds of a feather flock together and familiarity breeds contempt, whereby the groups themselves reinforce stereotypical behaviors. The results of this study support increasing cultural diversity in schools for expanding and improving self-identity.

Connections. Identity formation deals not only with the transmission of cultural values, but also with a growing sense of connection between oneself and an ever-expanding community. Hart (2005) stresses the need for moral development and education with moral identity based on five influences. The first two are personality traits and social/family structure that form the foundational moral development. These two influences change slowly and may be beyond willful control, indicating that childhood personality traits and broad patterns of family functioning are difficult to alter. The last three influences, moral cognition, self and identity explorations, and opportunities are more flexible, changing the moral identity of a person, and can be addressed through education. For example, seeing that they have helped others enables individuals to become connected to their community.

Participation in ECA is positively associated with higher levels of school connectedness, according to Marsh (1992). This finding is also true, according to McNeely, Nonnemaker, and Blum (2002), who extrapolate the research on family connectedness by Eccles and Early (1997) to the school environment. They state that when students feel connected to their school, they report higher levels of emotional well being. In addition, they cite teachers who are empathetic and consistent, encourage student self-management, and allow students to make decisions. Such teachers establish a classroom climate that also improves school connectedness. Marsh (1992) finds school size impacts school connectedness. McNeely, Nonnemaker, and Blum (2002) add that segregating schools by race or gender does not. Kao (2000) certainly supports this.

Psychological Adjustments. Besides cultural values and connectedness, identity formation incorporates psychological adjustments. Hansen, Larson, and Dworkin (2003) and Hansen, Larson, and Moneta (2006) use an animated computer-administered protocol, termed YES (Youth Experiences Survey), to assess students' perceptions of their experiences. In their studies, youth report that higher rates of learning and positive developmental experiences occur significantly more often in ECA than in academic classes or when socializing with friends (Hansen, Larson, & Dworkin, 2003). According to both studies, faith-based activities offer more experiences for identity formation, emotional regulation, links to adults, and interpersonal development in comparison with other activities, while service, community vocational and sports activities develop teamwork, positive relationships, and social capital. YES results depict youth activities as being associated with 1) personal development, in terms of initiative or effort, identity exploration and reflection, as well as overcoming fears, learning time management skills and problem-solving and 2) interpersonal skills and relationships, such as teamwork, leadership and group process skills, peer networks and collaboration to reach common goals, as well as connections with adults.

Personality Traits. Identity formation is enhanced by cultural values, connections, psychological adjustments, and personality traits. Identity formation is enhanced by participation in ECA, which build positive self-esteem, confidence, feelings of competence and achievement, and self-efficacy. Jacobs, Vernon, and Eccles (2004) find that social self-perceptions are significantly related to the ways in which adolescents spend their time and to their involvement in pro-social or problem behaviors. Notably, adolescents who are most self-confident about their social skills and those who are most willing to go to great lengths to make and keep friends spend significantly more time with peers than those who are unconcerned or anxious about their social skills.

Early studies by Ames and Ames (1984) report personality traits, such as persistence, common sense and dependability correlate with achievement as highly as intelligence. Surveying 4,012 college freshmen (1813 males and 2199 females) with an average age of 19, Tavani and Losh (2003) show significant positive correlations for academic achievement with self-confidence as well as with student expectations, parental educational levels, and motivation. Olszewski-Kubilius and Seon-Young (2004) document the increased self-confidence, especially critical for gifted adolescents, that comes from the support and recognition by important adults for participation and achievements in ECA as well as the “decreased time spent on risky behaviors” (p. 110). According to Cushman (2006), students need a sense of urgency, purpose and meaning in ECA, with hands-on activities, adults willing to learn from students, and high-interest topics as other ways to acknowledge the importance of students’ passions and feelings of competence. As mentioned earlier, Fredricks, Alfred-Liro, Hruda, Eccles, Patrick, and Ruan (2002) find that peer relationships, perceived competence and challenge, and emerging identity are significant factors for teenagers when choosing to quit or remain involved in ECA.

Social Positioning

Social Interactions. Identity formation is a complex process, involving acquisition of cultural values and aspirations, connectedness to ever-expanding communities, psychological adjustments and personality traits, addressed previously. The processes that form and shape identity and position occur through social interactions with others. An examination of how these social processes occur offers important understandings to explain participation and interactions in ECA as well as recommendations to guide ECA structure and function.

An individual grows, forms an identity, and matures to assume a place in society. While some would credit physical attributes or evolutionary processes as determinants for an individual’s position in society, socioculturalists, like Wertsch (1991) and Bruner (1990) maintain that the individuals are subject to considerable maneuvering, or ‘positioning’ into their social niches. How this positioning occurs is the subject of much debate as to whether it is the actions of the individual in the environment or the socialization process within the culture that govern attitudes and beliefs. Wertsch (1991) makes certain assumptions, such as focusing on universals or socio-cultural 'situatedness' determines what deserves attention and that actions, rather than individuals or situations considered in isolation, are the entry point for analysis. Bruner (1990) argues that "culture and the quest for meaning within the culture are the proper causes of human action" (p. 20-1). He asserts that the mind and thus, mental actions are socially situated.

Social engagement builds on Vygotsky's (1978) premise that the "social dimension of consciousness is of primary importance in position" (p. 22). According to Vygotsky, a child performs better with the assisted help of *more capable peers* than the child could perform without help. This "zone of proximal development" (p. 27) is defined as the distance between a child's actual developmental level as determined by independent problem solving and the higher level of potential development as determined through problem solving under adult guidance or in collaboration with these more capable peers. This premise recommends that assessments should be made by independent problem-solving while instruction should be tied to potential, rather than actual, development levels.

Vygotsky (1978) maintains that cognitive structures are formed socially and then reconstructed internally, a process also affirmed by Scardamalia, Bereiter, and Lamon (1994) in their three-year study using the Canadian Tests of Basic Skills test scores, despite a decreasing sample size from 122 to 21 third to sixth graders. Vygotsky (1978) attributes a child's improvement to socially distributed cognition, or the social interaction with more capable peers. One of Vygotsky's (1978) basic premises is that higher mental functioning in an individual derives from social life, maintaining that human actions on both social and individual planes are mediated by tools and signs. These integrated social communicative processes influence the positioning of individuals into their social roles, the views they hold of themselves within the social culture and the actions they take.

Socially situated theories view learning as a ‘process of increasingly central participation in communities of practice and positioning voices’ (Dison, 2004, p. 83). For young children, this sociocultural communication and positioning begin with the dominant voices in the home community as parents initialize the positioning of children. Parents impose positioning upon their children with boundaries, based on their own experiences, attitudes and beliefs. Even when youth expand their learning environments beyond the home, parental influence, although decreasing in impact, is still apparent. Based on four-year survey data from over 100,000 students in 134 predominantly white, upper-middle class public middle and high schools in New York, Bishop, Bishop, and Bishop (2004) verify the extensive influence of parents holding participation in extracurricular clubs in higher esteem than they do in reaching higher academic achievement. Bishop, Bishop, and Bishop (2004) rationalize that perhaps parents believe extracurricular activities teach “teamwork, time management, self-discipline, and other skills important later in life and on the job” (p. 235).

Peer Cultures. These social communicative processes continue as peer cultures and communities take prominence as the adolescents’ positioning voices. Based on talks with 71 girls and interviews with eighteen girls, ages 11-16, who reflect the multicultural demographics and schools of Vancouver and Lower Mainland of British Columbia, Currie, Kelly, and Pomerantz (2007) relate how girls position themselves and others. This positioning occurs, based on what it means to be a girl, through social cliques, the dynamics of inclusion and exclusion in peer groups, and the nature of their interactions.

The researchers use Gee's (2002) discursive strategies that include the mental entities and social actions, that is, values, ways of acting, feeling, interacting and believing, gestures, clothing, objects and cultural contexts. Currie, Kelly, and Pomerantz (2007) summarize that these positions determine how individuals ascribe meaning to people, places, and things, or rather how the positions interprets and applies meanings for individuals.

Eckert (1989) documents how student identity is strongly influenced not only by participation in specific ECA, but by social peer groups. These peer groups ultimately lock individuals into corresponding psychological outcomes with regard to academic and economic achievement, e.g., 'jocks' are college-bound middle-class students connected to the school social system while 'burnouts' are working class students detached from the school social system. The longer the students stay in these positions, the more likely they are to take on the characteristics and aspirations of the stereotypical positions they assume. Eckert's (1989) work parallels that of the group norms and stereotypical reinforcements described by Kao (2000), but without the racial and ethnic components. Kessels (2005), in her study of 198 German eighth and ninth graders, also shows that social stereotypes are reinforced within the peer culture.

Eccles and Barber (1999) concur with Eckert's (1989) findings and affirm that adolescent identity formation is often associated with specific ECA, which in turn are associated with different contextual values, skills, behaviors and achievements. They link five prevalent activity-based identities (princess, brain, basket case, criminal and jock) with specific patterns of development outcomes. Eccles, Barber, Stone, and Hunt (2003) classify ECA into five position types, linked with patterns of developmental outcomes and identity (subsequent substance abuse, psychological adjustment, even educational and occupational outcomes). They maintain that outcomes differ, based on the type of ECA in which the students participate and their social identity group.

Bishop, Bishop, and Bishop (2004) define cliques, or selective groups of individuals that share or accept the group's influence for similar attitudes and norms for behaviors. These cliques include 'jocks,' 'preppies' and 'populars,' (identities that carry prestige and bring power) as well as 'freaks', 'Goths', 'losers', 'druggies', 'nerds' (the bottom of the status hierarchy) with 'floaters' and 'normals' (the middle of the social status groups). Bishop, Bishop, and Bishop (2004) clarify that shifts in these positions can occur when transitioning to middle school or changing schools. Within a month of changing schools, however, students know how they have been positioned by others and these quick categorizations are difficult to escape after that. Although downward mobility is possible, "upward mobility necessitates becoming an entirely different person" (p. 237). Peer interactions further delineate the distinct boundaries of micro-social positioning, according to the study by Bishop, Bishop, and Bishop (2004), through peer harassment, school engagement, crowd selection, and school norms.

Kinney (1993) reports about middle school students labeled nerds who entered high school and by participating in ECA, gained self-confidence to reconstruct themselves as 'normals'. A retired English teacher, Barlow (2007) repudiates the mal-aligned representations of nerds in most high-school-targeted movies and provides an example of individuals in a science ECA competition who do not fit the general perceptions of high school nerds. Cross (2005) argues the negative connotations of the terms, nerds and geeks, used for gifted and talented students seem to be decreasing in severity. In fact, she feels that the term, 'nerd' has taken an almost neutral role and 'geek' is almost a positive position.

Positioning assumes a dominant voice in many venues at schools. The impact of these social interactions is also evident in the positions individuals assume within a classroom, school environment, or the larger community culture. Using previous research data of 250 students from a primarily white, working- and lower-class rural community in the Midwest, Eder and Parker (1987) maintain that male athletic with female cheerleading ECA sporting events that dominate high school social events further embed adolescent peer culture stereotypical identities, reinforcing male achievement and competitiveness and female concern for attractiveness and appearance. Giroux (1994) urges educators to be sensitive to how youth are increasingly being addressed and positioned through the popular media, changing economic conditions, and an escalating wave of violence. He cites several recent Hollywood films about youth culture that reinforce dominant racist and cultural stereotypes. Mahar (2001) in her daily teacher's journal and interviews with five students, suggests that the "teacher's authoritative voice is not a dominant force when gender, race, and power subtexts are seeping into the classroom from nonacademic settings" (p. 200). Peers exert considerable pressure to conform to defined positions as well as the acceptable actions within those increasingly prescribed boundaries.

Trajectories of Identification

Social positioning defines future trajectories of identification. Lemke (2000) offers a definition of trajectory of identification as the experiences of individuals as they travel through time and space. Wortham (2008) more succinctly describes it as a fluid identity when an individual enters a new group, an identity that becomes increasingly defined in a certain way, where others begin to expect the individual to act in a certain prescribed way, and finally, forming a more durable identity with consistent future aspirations and opportunities. Positions once defined and locked become the identity framework with distinct boundaries from which to interpret other scenarios, present and future situations as well as those trajectories of opportunities, as evidenced in Bamberg's (2004) analysis of a discussion between five 15-year-old boys discussing female promiscuity. Observing the positions they take during the interactions, he discloses how positioning becomes part of their identity construction.

Drawing on data for 1,259 adolescents from the Michigan Study of Adolescent Life Transitions, Eccles and Barber (1999) examine benefits and risks of ECA participation into five activity types (prosocial, team sports, school involvement, performing arts, academic clubs) and then link them to educational trajectories. For example, team sports and prosocial involvement are both linked to positive educational trajectories, but team sports are linked to high rates of drinking alcohol while pro-social involvement is linked to low risky behavior rates.

Sutherland's (2005) study of six 16-year-old Black girls documents how they constructed meaning from a literary work in their high school English class. The girls used the text to reflect on how they were socially positioned within their school, community, and outside their community and were expected to look and behave in particular ways according to those ascribed values and ways of being. But as positions became more delineated and perhaps offered an affordance of clear expectations, the girls realized that the boundaries of their possible future identities were becoming more constrained or restricted. This concept of positioning in the social community by others and the lack of flexible transitions between categorizations once positions are voiced is the same situation described by Bishop, Bishop, and Bishop (2004).

Role of Education in Changing Positions and Boundaries

Education places an important role in changing positions and boundaries. Lemke (2000) urges teachers to remember that no matter how hard they try to homogenize classes, there will always be differences in engagement, talents, identities, positions, and long-term goals. Although he asserts there are no shortcuts in the formation of identity, Lemke (2000) reiterates that each step along the identity formation trail changes the resulting trajectory and the subsequent way individuals react and interact with their environment. This is similar to Bakhtin's assertion that utterances also shape future utterances in an iterative way. Lemke (2000) further reiterates that with each step, the relationship between individuals-environment is different with diverse parameters and trajectories. According to Lemke's (2000) precepts, repetition increases fluency and literacy. A single interaction is momentary, but strong interactions or those that occur again and again in a lifetime become basic to identity and make up the thing called Self.

Van Bockern, Wenger, and Ashworth (2004) maintain that significant others (teachers and parents) can impact or enhance these trajectories of identification with expectations, values and safety. Using NELS:88 data for 3,359 eighth graders, Tai (2006) shows that students with higher academic expectations in the eighth grade achieve higher levels of educational attainment than those with lower expectations.

Wortham (2008) describes how identity development can be facilitated by discussions of curricular themes in a classroom, demonstrating the impact that teachers can have on development and direction of student identities. Sutherland (2005) shows how identities ascribed by others serve as boundaries that constrain the trajectories of identification available to individuals while education enables individuals to negotiate those boundaries, affording a wider range of future trajectories possible. Underiner (2000) encourages students in her drama classes to “recognize and confront privileged identities, arguing for multiple positioning and transformative alliances across categories” (p. 1293).

Based on their study of three adolescent girls' own accounts of their instructional and institutional interactions and experiences over a three-year period, Fairbanks and Ariail (2006) urge teachers to 1) recognize students' identities and positions within a complex set of social contexts and 2) provide opportunities to “develop embodied capital that will allow students to use critical resources, such as literacy, to meet the present and future demands required in school and society” (p. 310). In their ethnographic study of seven students in seventh grade regarding youth resistances encountered in middle schools, Field and Olafson (1999) document the need for classroom environments that take into account individuals' backgrounds, strengths and needs as well as offer places where identity and differences can respectfully co-exist. In an effort to improve student connections to school and science, O’Neill and Barton (2005) investigate the change in positioning and future trajectories for students in their science ECA in New York City.

Role-Play. While boundaries constrict future trajectories, education can widen them with role-play. Students may first need to see the forest in order to appreciate the trees. Perhaps, more lasting identity formation will occur more fluently if students have the opportunity to test the ‘fit’ of various roles before accepting them for perpetuity. More specifically, Guest and Schneider (2003) suggest that the activity-based identities within their social context determine the differential impact of ECA, assuming an activity-based identity means taking on the values associated with it, albeit temporal and contextual. For Rounds (2006), exploratory identity work and role-playing are essential and allow individuals to test the ‘fit’ of various identities, while still in the formative stages. Powell (2004) maintains that adolescents have many identity conflicts resulting in low self-esteem and suggests supportive environments that allow adolescents a chance to explore new roles and to develop their own unique identity in order to provide the formation of a strong independent sense of self, and to be able to progress to higher developmental stages.

According to Pinciotti (1993), during role-playing, make-believe or creative drama activities under adult guidance, students build knowledge, skills, discourse patterns, dispositions, and feelings through their interaction and collaboration with others under the guise of different beings. Later, these qualities become integrated into private thought, covert behaviors, and a shared consciousness, fostering identity formation and abstract thought. She maintains that the long-term benefits of role-playing, thinking on one's feet, problem solving, collaboration skills, a sense of presence, empathy, the ability to put ideas into action are essential qualities for success in the real world.

Currie (1991) maintains that role play, or make-believe is important for cognitive development and that by projecting ourselves imaginatively into the situations of others, we learn to explain and predict the behavior of others. Role-play and the opportunity to ‘test the fit’ of a role before assuming the role as an adult are effective strategies. Future research is still needed to assess the impact of role-playing and costumes in the identity formation experiences of students. McCormack (1990) advocates that teachers incorporate showmanship strategies, and costumes where applicable, to enhance student interest and learning in science.

Costumes. While there are studies involving role-play, there are relatively no studies on wearing costumes. Role-play wearing costumes employs the physical senses in a unique manner reminiscent of carnivals. Carnival is also a concept described by Bakhtin (1965a) of social situations where rank and regular conventions are set aside and genuine dialogue becomes possible. Each character has a voice, is heard by, and hears others. Bakhtin (1965c) ascribes carnivals as unifying connection between a community of participating individuals free of socioeconomic and political organizations where all are equally important. Bahktin's (1965d) notion is that donning costumes and masks offer a unique perspective of time and space, a sense of timelessness (matching the concept of 'flow' advocated by Csikzentmihalyi, 1988) coupled with heightened awareness that makes each person feel they are a part of community, rather than separate individuals. Bakhtin (1965b) argues that carnival is the place for working out a new mode of interrelationship between individuals free of the restrictive ranks and positions of society. He also contends that standing outside of a culture looking in helps individuals to understand their own culture. This process offers new possibilities, reveals hidden potentials, promotes "renewal and enrichment" (p. 271) and creates new potentials, new voices. Bakhtin (1965b) is quick to distinguish that the carnival with its grotesque mutilations of which Rabelais wrote is quite unlike modern carnivals.

Technology. Technology has drastically changed the children's role-play games of the past (from Cowboys and Indians to Dungeons and Dragons) and captured the attention and interest of young people everywhere with countless new video role-play simulations and virtual realities (X-Box, Moose Crossing, MUD, etc.). According to Appelman (2005), educators should embrace new technology that offers the affordance [James Gibson's (1977) terminology for the interaction between the perceiver {human} and the perceived {the environment}] of quick displays, user controls, sensory immersion, rapid interaction, cognitive and affective change, mobility and easy access to information. Game designers work toward certain learning goals and Appelman (2005) challenges educators to create experiential modes in line with Dewey's (1916) tenets by replacing odoriferous creatured-classrooms with virtual laboratories of digital multi-layered frogs and unlimited chemicals. He urges learner-centered schools to capitalize on the excitement generated by video games and role-play simulation experiences of their students by incorporating complex gaming and simulation environments into educational contexts and creating "Immersive Learning Environments" (p. 64). Dickey (2003) concurs and champions the affordance of technology because it offers 3-D virtual realities ("Active Worlds"), constructivist learning environments, 'just-in-time' teaching, chat rooms for increased interactions, and peer mentoring (more capable peers concept). But she also acknowledges the constraints of the technology with students dual role-playing with outside identities during chat times and visiting other Worlds, time lags and character limitations during synchronous class meetings, duplicate avatars and disruptive students acting out (she warns them and then 'mutes' them).

Volunteerism

Increasing long-term social engagement and enhancing social positioning improve psychological adjustment of students to become our future citizens. Utilizing the data from the Carolina Longitudinal Study, Mahoney (2000) validates increased long-term social engagement and adjustment benefits with ECA, findings that are also aligned with the work of McLaughlin and Irby (1994), and Posner and Vandell (1999). Based on data from 242 seventh and eighth grade students, Handel (1986) concludes that the adolescent socialization process is best indicated by extra-curricular mathematics, science, or computer participation.

Based on data from 924 high school seniors in the Youth-Parent Socialization longitudinal study in Michigan, Janoski, Musick, and Wilson (1998) support encouraging youth to become engaged in service or community work to develop a mature adult population of volunteers. They advocate making volunteer work required, which gets students into the habit of service work, so that as adults, they will be in the habit of volunteering. Fisher and Ackerman (1998) propose that participation in organizations that effectively encourage people to volunteer and contribute time to a worthy cause is dependent on a combination of group needs for success and promised recognition. Regnier and Planty (2003) warn, however, that mandatory volunteer service decreases the likelihood of adult volunteers.

Hanks (1981) and earlier, Hanks and Eckland (1978) use an extensive database of 10,425 black and white respondents from the Educational Testing Services, the National Longitudinal Study of High School Seniors, to further examine the long range impact of ECA into adulthood. He states that

> Independent of social origins, ability, and academic performance, participation in ECA has relatively strong direct effect on participation in adult (voluntary) associations . . . which in turn, increases voting behavior and decreases political alienation, thus demonstrating the very broad and long term effects of adolescent socialization in ultimately linking the individual to the political order (p. 490).

ECA participation fosters the development of adult volunteers and conscientious citizens.

Limitations of Identity Formation and ECA Studies

The studies cited for identity formation, positioning and trajectories of identification involve fewer participants than those in previous sections; some studies, however relevant, do not directly relate their findings to ECA participation. Limitations in these studies with respect to identity include small differences, use of self-ratings, levels of ECA participation determining extent of identity benefits, multiple variables impacting the results, questionable methodology, and unaddressed variables. While participation in extracurricular activities appears to consistently and significantly correlate with positive gains in self-identity, the differences are generally small (Guest & Schneider, 2003; House, 2000; and Marsh, 1992). Xie, Mahoney, and Cairns (1999) urge caution for studies utilizing self-ratings because their findings for two longitudinal cohorts of 220 fourth – 12th graders and 475 seventh - 12th graders show an apparent self-enhancement, with student self-ratings significantly higher and more unreliable than teacher ratings, which are more robust predictors of academic success.

Guest and Schneider (2003) suggest that the levels of participation in ECA should also be taken into account to determine the measure of identity benefits students receive from them. Even with a limited data source for their study, namely, just the reports from the adolescents, Darling, Caldwell, and Smith (2005) find that adolescents have different experiences within extracurricular activities with respect to the commitment and time involved in the activity, and the timing of the activity within the school year, factors that also impact the results. Hansen, Larson, and Dworkin (2003) and House (2000) point out that research studies have not addressed the specific processes or experiences within an ECA that are actually associated with these positive impacts on identity. McManis

(2003) and NEA Editors (1999) interview William Pollack, assistant professor of psychiatry at the Harvard Medical School, who urges educators to address the ‘boy code,’ of boys who are often slighted for not adhering to the cultural stereotypes for males in our society, and for deciding to enter typically female roles, such as teachers.

In addition to the multiple variables that impact findings in these studies, some studies have come under attack for their controversial methodology and interpretations, particularly those of Holland and Andre (1987), who define five areas of adolescent development; and of Yarworth and Gauthier (1976), who argue that ECA do not have the same appeal to every student and that many students do not participate in ECA in order to complete a ‘high school life experience’. Methodologies range from quantitative computer-administered surveys of thousands to qualitative studies based on one or two person interviews and personal journal reflections, with many open to questions of reliability, validity, and particularly, generalizability. House (2000) advocates further study into applicability of findings to other cultures, multiple institutions, and other types of schools.

A Summary of Identity Formation and ECA Studies

In addition to the benefits of successful engagement, ECA also enhance identity formation in students. Identity formation deals with the appropriation of 1) cultural values through a variety of processes and group images; and 2) community connectedness. ECA, particularly faith-based ones, offer higher rates of learning and positive developmental experiences than academic classes. ECA reinforce positive personality traits and psychological outcomes, but some studies document the varying impact of ECA due to social context as well as the basis for activities, timing, peer groups, and levels of involvement. Many studies capitalize on ECA's social and personality skills development, but lament the stress or anxiety, inappropriate adult behavior, and negative peer or group dynamics that occur in some ECA. Future research on identity development and ECA is still needed to assess a) how different experiences in ECA with respect to the levels of commitment and time involved in the activity, b) the processes within ECA that produce these benefits; c) the timing of the activity within the school year; and d) the applicability of these findings to other localities of other or greater cultural diversity. More studies are needed on the impact of the sponsors' training or implementation of developmental concepts to foster identity formation. Further research on how moral identity development can be fostered in ECA is also needed. Possibilities for identity reflection and position re-alignment through the use of costumes and role-play are gaining more attention and offer significant findings for ECA design and implementation.

A Summary of the Review of Related Literature

ECA have the potential to enhance school curricula and experiential learning for today's youth. The successful development and deployment of ECA depend on many factors as well as the collaboration, talents and resources of parents, teachers, schools and their communities. While studies document certain limitations and risks, the preponderance of studies acknowledge the considerable benefits ascribed to participation in ECA to justify the continued efforts and invested resources for providing them. ECA provides these benefits through the successful engagement of students, behaviorally, cognitively and emotionally. Participation in ECA benefits students in their identity formation, social positioning and ultimately, their trajectories of identification. The significant social capital attributed to ECA participation as well as the disparity between the vast array of general, non-science ECA and limited science ECA depict the substantial opportunities to enhance science education through extracurricular activities.

In order to investigate these possibilities, this mixed methods study takes a retrospective look at the ways in which a specific science club successfully engaged students in a socially constructive venue as ‘science experts’ and teachers. The methodology for reconstructing that reality from the students’ memories entailed an exhaustive search for past participants, surveys and interviews that took respondents down Memory Lane, and ethical, trustworthy data analysis.

Chapter Three: Methods

Mixed Methods

The design of any research study is based on its purpose. While some quantifiable data has been collected during the study of the ECA, "Suzy Science and the Whiz Kids," the primary objective dictated a descriptive, or qualitative research study, one that seeks to answer the questions, "What is . . ?" or "How is . . ?" Qualitative methodology dictates different types of data collection strategies and analyses, but is still empirical research that offers more flexibility and inductive responsiveness to inquiry discoveries. Berg (2004) asserts that rather than sterile collections of numbers, qualitative studies allow researchers to share in the understandings and perceptions of people and to explore how these individuals structure and give meaning to their daily lives within their so-called life worlds. Bruner (1990) cautions that despite the fact that what people *say* and what they *do* are often different, we should not ascribe more truth to one behavior over the other. Culturally sensitive psychology is concerned with what people say their worlds are like. Bruner (1990) maintains that it is "culture, not biology that shapes human life and gives meaning to actions by situating them in interpretative systems" (p. 34).

Borman, LeCompte, and Goetz (1986) maintain that both qualitative and quantitative researchers are doing science investigations, if science is appropriately defined as "a specific and systematic way of discovering and understanding how social realities arise, operate and impact individuals, and organizations of individuals" (p. 11). When a study involves an event that has taken place over a number of years, such as the subject of this study, a science club, a longitudinal trend study appears to be the most appropriate methodology, in that the student sample base changed within a school population that was also changing. This means that the study is useful in studying the changes in the general population that changed constantly. Club members changed from year to year as students graduated or entered high school. Because no measures were made at the onset of the event, this becomes a retrospective study, looking backward in time to study a phenomenon. It is not the intent of the study to compare it with or show correlations with other extracurricular activities.

At this point, it may still appear counterintuitive to conduct the study of a science club by some qualitative methodology rather than by just a quantitative one until one examines the three tenets of qualitative inquiry in light of the science club itself. There is also some clarification needed regarding the significant social engagement and interactions entailed in the functioning of the club. To better understand this methodological decision, consider Shank's (2006) division of qualitative research into two domains, qualitative inquiry and qualitative science. He clarifies that while qualitative science is grounded in the scientific method and advocates the use and testing of theories in much the same way as empirical studies, qualitative inquiry is a systematic, but more complex alternative to qualitative science (p. 7). Qualitative inquiry is different from empirical or quantitative inquiry in that it is not intended to reduce things to the simplest terms, but rather to study them in the broader socio-cultural context, framing them in an ongoing conceptualization of a holistic entity. Thus, examining the nature of the engagement and positioning of students in a science club in its socio-cultural context in order to propose a theoretical model as the end-product dictates a balance of qualitative inquiry approach as well as quantitative methodology.

There are three important tenets to qualitative inquiry, according to Shank (2006, p. 10). The first basic tenet of qualitative inquiry is that the researcher matters. In this case, it is significant to know that the researcher is the sole creator and sponsor of "Suzy Science and the Whiz Kids©." The second tenet of qualitative inquiry is that the inquiry into meaning is in the service for understanding. This study examines the memories of students about their engagement and positioning and considers what implications there may be for other science ECA. The third tenet is that qualitative inquiry embraces new ways of looking at things. In this case, science ECA that have been traditionally competitive in nature, particularly, science fairs and independent research competitions are now viewed through the lens of one unique science ECA that offered new possibilities and opportunities for students to engage and be positioned in a successful collaborative, service-oriented venue based on social interdependence.

Based on these tenets and Creswell's (2003) four factors of implementation, priority, integration and theoretical perspective, the most appropriate methodology for this study was a mixed methods strategy, a mix of qualitative and quantitative research, or a "numbers and narratives" (p. 397) approach, as advocated by Nash (2002) for studies in education. The purpose of this study was twofold. First, it was to determine the nature in which the club engaged students in science and teaching while expanding their social communications processing skills. Secondly, the study ascertained the nature in which participation in the club allowed students to explore new identities and offered them opportunities to develop possible future trajectories of identification, trajectories with different sets of skills, actions and behaviors with respect to real-world positions, and specifically, in science- or education-related career fields. The quantitative portion of this study collected primarily numerical and ranking data on specific memories related to the club activities. The qualitative portion examined the phenomenological aspects, delving into the more subjective, situational, and emotional nature and meaning of the memories. These data triangulated with my reflected memories, the club structure, archival records, and member database.

While nostalgia, or the retelling of pleasant memories, lacks research rigor, this retrospective research study offers a new lens by which to recapture the people, their meanings and social interactions of the past that influenced or shaped their present development trajectories, in order to provide a better understanding of human behavior that shapes the future (Berg, 2004). Atkinson and Delamont (2006) stress that narratives emphasizing social and cultural contexts have important functions and moral force for social action and interactions. If meanings are derived from the social processes of people interacting, as Blumer (1969) suggests in his concept of social interactionism, then "reality for people is based on these meanings and the interpretations that they have given these situations" (p. 5). There are multiple interpretations of reality and everyone is a part of reality and its changing nature. Thomas and Swaine (1928) further clarify that "it doesn't matter if the interpretations are correct; to the individuals, their interpretation is reality to them" (p. 572). By describing and building an understanding and awareness of these interpretations within their retrospective setting and situation, concepts based on those interpretations come together to form a cohesive theory (Shank, 2006). Brown (1988) stresses that researchers need to focus on the processes, not the outcomes, involved in order to help educators design effective ECA. The second purpose of this study and my goal is that a theoretical framework of an engaging and socially constructive high school science ECA could be proposed from the insights gleaned from the literature review and the reconstructed *reality* from the students' memories. Mixed methods will provide the most comprehensive approach in its formulation.

Design of the Study

An Overview

Through mixed methods, qualitative and quantitative data from adults who participated in a specific high school science ECA was collected. Online surveys were utilized and offered valuable information. Qualitative data was also generated through semi-structured interviews with former members in a manner described by Merriam (1998). Analyzing survey responses and individual interviews along with archival data from the club sponsor, that is, club records and other documentation triangulated data to increase validity, as advocated by Maxwell (2005). Data was transcribed, then tabulated and confirmed through cross checks on MS Excel spreadsheets. Data analysis entailed using coding schemas with interpretational analysis and inter-rater reliability. Content analysis was used to identify patterns and verify meanings with outliers.

Targeted Population

Targeted participants for this study were the former members of the science extracurricular club, "Suzy Science and the Whiz Kids©" (see Appendix A). This club was a unique science ECA in comparison to those reviewed in the previous chapter with respect to two characteristics; first, the club's mission was not competitive, but was collaborative and service-oriented, and second, participants (high school students) wore colorful costumes and assumed roles of science experts and teachers while performing science demonstrations for elementary school children. The club is my copyrighted creation and was implemented for fourteen years from 1983-1998. For the first ten years, the club was offered to students in a large suburban high school with over 2,300 students (hereafter, referenced as School A) and for another four years, the club was offered to students in a small private suburban school of approximately 500 students (hereafter, referenced as School B). In both cases, club membership had limitations. Both schools required passing grade point averages (GPAs) as a prerequisite for participation in any club program, although ECA prerequisites is a practice decried as being too restrictive by McNeal (1999), Morgan and Alwin (1980), Ostro (2006), and Pipho (1986). In both schools, students were also required to be concurrently enrolled in, or have successfully completed a chemistry course. This ensured that all participants had passed essential safety tests and that all members and their parents had signed school safety contracts.

Attendance records from club files were used initially to classify members into two groups as shown in Table 1. There were 352 active members (82% who signed up and participated in the club activities throughout a given school year) and 78 non-completers (18% who signed up to join the club in the first month of school, but never returned or failed to further participate in the club during the school year). Of the 78 non-completers, 44 students (56 %) had already selected characters and science demonstrations that they would perform as Whiz Kids with the club. This indicated that they did not leave the club due to a lack of costumes or club inelasticity. This finding is contrary to that of Crosnoe, Elder, and Johnson (2004) and Morgan and Alwin (1980), who report that with increasing school size, ECA participation and its benefits decrease due to inflexibility and inelasticity to allow for increased participation.

During its operation, the club composition changed from year to year depending on the individuals entering and leaving (graduating) as well as the change in school location. Regardless of school size, students typically joined the club in their junior year and were members of the club for 2 years. More specifically, longevity records show that the average length of club membership at both schools was approximately 1.5 years, with 194 students (55%) participating one year, 138 students (39%) participating two years, and 20 students (6%) participating three years.

Table 1. Club Membership in School A and School B

Suzy Science and the Whiz Kids Club Membership	**No. of Club Members**	**Average Grade when Member Joined**	**Member for Max. # of Years Possible**	**Member for Multiple Years**	**Averge No. of Years in Club**	**Years in Leadership Role**
School A	235	11.1	177	90	1.4	45
School B	117	10.9	104	68	1.6	26
CLUB TOTALS	**352**	**11.0**	**281**	**158**	**1.5**	**71**
Club Non-Completers	**No. of Club Members**	**Average Grade when Member Joined**	**Costumes Demos Chosen**			
School A	69	11.3	35			
School B	10	10.5	9			
CLUB TOTALS	**79**	**10.9**	**44**			

The club's overall composition (see Table 3) included 235 students (67%) from School A and 117 students (33%) from School B. Membership databases showed 230 females (65%) and 122 males (35%), with 293 Caucasians (83%) and 59 non-Caucasians (17%) (African-Americans, Asian-Americans, Hispanics, Pacific Islanders, etc.). Regardless of the grade level at which they joined (sophomore, junior or senior), 281 students (80%), with 177 students (75%) in School A and 104 students (89%) in School B) stayed in the club every year for the remaining years of their high school career. In School A, 90 students (38%) and in School B, 68 students (58%) belonged to the club for more than one year. Approximately 20% of the members, 45 students in School A and 26 students in School B, held leadership roles in the club one or more years.

Locating this select group of participants posed considerable challenge. It has now been twenty-five years since the first Whiz Kids made their presentation and ten years since the last presentation by the club. All club members have now graduated from high school, averaging 16 years since graduation. Most have completed additional educational training and are middle-aged (ages range from an estimated 25-45 years). Many are married with children and are living at locations including Alaska, Australia and Thailand, far removed from their high school family homes. In addition, participants' families have moved from their initial neighborhoods and according to alumni pages, most females have changed their names as they married. The original high school club contact information was the initial starting point in locating the current whereabouts of these former members. Access to alumni lists was restricted to only alumni members at the private school and the public school maintained no alumni lists.

Sampling Process

Most sampling (95%, according to Gall, Gall and Borg, 2007) is non-probabilistic, with relatively small sample sizes. This study used non-probabilistic sampling in its most common form, the purposeful sampling in that only former members of this club were invited to participate. The purposeful sampling methodology was a combination of convenience sampling and snowball sampling. Convenience sampling included those former students who could be located through public identification means or were still accessible to me. Means of public identification included club rosters and phone chains, school buzz books, telephone books, 411.com-type websites, open alumni websites, and Internet search engines. Snowball sampling was incorporated into the sampling process as family members relayed updates on their students and participants themselves offered to assist in the location of their peers. For this study, the participants were purposefully selected as being *experts* (regarding this ECA), and were interviewed for their special experiences and competencies to provide information-rich cases, not just average opinions (Gall, Gall & Borg, 2007). Since only club members and only those members who could be located, were invited to participate, the study generated an intensity sampling, while avoiding the problem of "extreme sampling" (Gall, Gall, & Borg, 2007, p. 180-182) and affords greater applicability of the findings to those in similar situations (Gall, Gall, & Borg, 2007).

Rosenthal and Rosnow (1975) find that volunteers tend to be a biased sample of the target population and according to Blodgett, Boyer, and Turk (2005), self-selection introduces sample bias. For this study, participants already belonged to a very select group, so all verified members of "Suzy Science and the Whiz Kids©" were invited to participate in the survey and in the interviews. The introductory letter and interview form are shown in Appendix B. Only those members who actually attended practice sessions and participated in the performance events had the experiences necessary to respond to the questions. Thus, based on our previous experiences together, it was anticipated that full-time members contacted would be willing to participate in the study and assist in any way possible while non-completer members contacted would likely decline to participate in the study. Although all efforts to contact members were recorded as to who accepted and who did not accept, there were no identifiable factors associated with nonparticipation. Therefore, this study reflects only the participation of full-time members and with data collected about their experiences and memories of the extracurricular club. Based on the elapsed time since the club's functioning, current identification, and location constraints, complete sampling was not possible.

Records of all calls and responses were recorded in an Excel spreadsheet. Eleven former non-completer members were found, but all declined to participate in the study, saying that they did not remember being in the club. This seems understandable since the records show that they had only shown up for the club on the first day to register, but had not participated in any of the activities. Of the former active members, 139 (40%) were located and contacted to participate in the study. Of those contacted, 115 (83%) acknowledged receipt of the invitation to participate. Of those acknowledging receipt of the invitation, 92 (80%) former active Whiz Kids completed the online survey.

Invitations to participate in the online survey also contained forms for recipients to complete if they were interested in being interviewed regarding their club participation. Five volunteered and completed the forms. Using quota sampling in order to represent the relative composition of the club membership with respect to school, gender, longevity in the club, and race, eighteen more former members were personally contacted to request an interview. Five of the eighteen declined. One was in the process of moving out of state, one had just delivered a baby who was on medical alert in the hospital, two were leaving for extended international business travel, and one was in the military shipping out in a submarine. The remaining 18 former Whiz Kids were interviewed. The average length of the interviews was 57 minutes. The total time spent on interviews was 17 hours 10 minutes, with a range of 27 minutes to 1 hour 49 minutes spent on individual interviews.

Participant Demographics

An initial perusal of the demographics and current status of the adult survey participants tend to support findings suggested by Rosenthal and Rosnow (1975), in that respondents who volunteered to participate in this study are a biased, albeit expert sample. In this study, participants are highly educated (97% college completion rates), more social (most located through social networking), mostly females (67%), in need of social approval (many apologized for delays in responding and for forgetting information), and appear to have higher social status (all with e-mail accounts and access to Internet) that may be higher than the selective target population.

The educational attainment of these respondents is impressive. Of the respondents for this study, 89% have completed a four-year Bachelor's degree with 52% having a Master's degree or higher and 8% with PhDs or equivalents. Eight percent have associate (two-year college) degrees and the remaining 3% have attended some college but have not received degrees (see Table 16). The high achievement levels of these former ECA participants add credibility to similar findings by Cooper, Valentine, Nye, and Lindsay (1999) and Mahoney, Cairns, and Farmer (2003).

The careers of these former members are far-ranging, but to address the focus of this study, careers have been cataloged according to science- or education-related occupations (see Table 2). Five respondents (5%) are currently in science teaching positions, 24 (26%) are in education-related careers, and 27 (29%) are involved in scientific, medical, engineering or technological fields.

Table 2. Careers of Survey Respondents

Career	No. of Respondents	Percent Respondents
Science teaching	5	5
Education-related	24	26
Science-related	27	29
Stay-at-home-moms	11	12
Lawyer	5	5
Non Science/Education	28	30

Eleven respondents (12%) are stay-at-home-moms (several are home-schooling), five (5%) are lawyers (some relate science used in their cases), and the rest (30%) are in various other non-science, non-educational careers. Equally impressive is the current volunteerism of these participants, which will be addressed later in the next section.

Although the surveys are posted anonymously, the special positioning within the club permitted the identification of survey respondents among former club members. For example, if members specified the year they graduated and the characters they assumed, positive identification was possible since every year each member received a character and costume for the entire year, as listed on the club roster distributed each year to its members. There were no duplicates issued. Each year, there was only one Suzy Science, one Pirate Pete, one Betty Bluebird, one Doctor Dan, etc. Thus, I could determine the identities and gender for each respondent. Although identities may be known to this researcher, no identifying characteristics are used in reporting their responses.

Characteristics of each participant are summarized in Appendix C.

Table 3. Percent Composition of the SSWK Club, Survey Respondents, and Interviewees by School, Gender, Race, and Longevity

Group	School		Gender		Race		Longevity		
Values	A	B	F	M	Cau.	Non-Cau.	1 Yr.	2 Yr.	3 Yr.
SSWK Club	67	33	65	35	83	17	55	39	6
Survey Takers	67	33	66	34	83	17	36	57	8
Interviewees	72	28	67	33	94	6	39	33	28

Instrumentation

According to Merriam (1998), the researcher is the "primary measuring instrument" for data collection and analysis in qualitative studies; the data is given meaning and interpretation by this "human instrument" (p. 7). Merriam (1998) explains that the human researcher is responsive to and considers the total context, can adapt techniques to the circumstances, is sensitive to nonverbal cues. The human instrument processes, clarifies and summarizes data and explores irregular or abnormal responses immediately as needed.

Personal Expertise

Chenail (1995) urges researchers, particularly new ones, to be open and present as much background information as possible for the readers about their position in the research. To establish the etic perspective for this study, it is imperative that I explain the unique position of this researcher. Foremost, I am the sole creator and sponsor of the extracurricular club, "Suzy Science and the Whiz Kids©." All field trips and appearances for the club were organized by me. As sponsor, I distributed call chains to all club members and organized them into squads, each centered around a different physical science topic. Students were always asked their preferences for squads, science interests or demonstration favorites, and friends, but squads were deliberately organized and balanced to ensure that each one had a female, a male, a strong science student, a non-Caucasian student, and an outgoing student, even if there were only three members in that squad that year. I ensured that no squad contained *only* females, *only* males, *only* sports team members, *only* non-Caucasians, or *only* science enthusiasts, or *only* any other singly-identifiable group. I wanted to make sure that each squad had the widest representation so every child in an elementary classroom saw someone in the squad with whom they could possibly identify.

My role also included acting as intercessory between students and administration for excused absences, between parents and schools to collect and file permissions notes and engage parents as chaperones, room mothers, lunch monitors, and drivers. The safety of the presentations was monitored at all times. All club meetings and training sessions were held in my science classroom, all their equipment was stored in my laboratory prep room, and I sewed/provided costumes for upward of 80 students annually. Whiz Kids had to stay ‘in character’ the whole time they were at an elementary school or performance, meaning they could not take off hot costumes or itchy wigs; make-up had to be re-applied after lunch. We practiced ‘crowd control’, ‘door-rushing’ and presentation skills as well as science demonstrations and safety skills. We talked, joked and studied for chemistry quizzes together as we rode school buses to our destinations. We ate lunch together, we built human pyramids together, we laughed together at funny stories we told, and we walked together in our costumes, passing out Tak-Hom-A-Lab flyers all over the neighborhood for the annual Homecoming parades.

My role as the club sponsor included presenting a detailed agenda to the elementary school faculty and verifying the proposed schedules one week prior to our school visits. Squad rotation systems were carefully tailored for every elementary school that we visited so that each individual classroom saw 3-4 different squads sequentially without interfering with their normal classroom schedules (elementary students leave their classrooms for music, art, library skills, computer skills, and content lesson exchanges as well as for lunch, recess and physical education). Squads worked in adjacent classrooms to reduce school distractions and noise in the hallways, and to make transitions between classrooms smoothly (a sample schedule is included in Appendix A). As I reflect back, I realize now that I never gave them breaks or bathroom time during the entire day and none of the Whiz Kids ever mentioned it to me. A reader may say I was treating them like adults. But no, it just never occurred to me to do that, not with all the schedules I had to merge, making sure all the classrooms had visits by the right squads and the same number of squads. The second grade classrooms wanted the squad with the magnets and the kindergarten teachers wanted the Measurements squad because those topics were in their science curriculum. Most importantly, I had to make sure that the elementary children would actually be in their rooms when we would be in their hallway and not going to lunch, music, art, reading or library, etc. Although I provided the scaffolding for the club and our visits, once we arrived at the school, I stepped back and let them run the show. During the classroom performances, I waited in the hallways with the school schedule, fresh amounts of chemicals, replacement parts, clean glassware, and extra prizes and handouts. I sat in the back of elementary classrooms periodically to verify the safety and accuracy of the science being presented.

The Whiz Kids brought their own spirit and exuberance to the club. They made up stories to tell with their demonstrations, e.g., selling lemonade at a stand to buy a puppy. They tailored their demonstrations and the scientific method to the level of their audiences, e.g., how to avoid pushing and shoving. Whiz Kids created their own demonstrations when they got tired of the others. They designed and sold annual sweatshirts with our logo on the front side and character names on the backside. Before Spring Break, they sold Eggs-perigrams (chocolate eggs attached to paper egg handouts describing experiments to do at home with eggs) to their friends. Whiz Kids performed for gifted and talented programs, Special Olympics, National Chemistry Weeks at the St. Louis Science Center, American Education Weeks at the local shopping malls, and marched in Homecoming parades. They distributed candy, prizes, science stickers and our Tak-Hom-A-Lab handouts. The Whiz Kids received Happygrams, candy grams and thank-you notes from me for jobs well done. Whiz Kids also received 'fan mail' from their young audiences and replied with suggestions for other similar experiments that young children could perform at home with their parents' permission.

In addition to sponsoring this club, I have an expansive and extensive career as a teacher, director, presenter and club sponsor, primarily science clubs and particularly, highly competitive science clubs (Science Olympiad, JETS, TEAMS, FIRST, Battle of the Burets, International Club, as well as Missouri Scholars Academy and George Engelmann Institute). Many of the Whiz Kids were also members of my other science clubs. As a veteran teacher, I readily recognize the need for and value extracurricular activities to enhance/reinforce student development and learning. My experiences in schools range from urban to suburban, from small to large schools, and from elementary to high school to university. The rigor of state-mandated curricular regimes and assessment programs as well as the administrative, professional and personal demands made on teachers are all issues that are familiar to me. I also have experience in working with students possessing a wide range of abilities and talents as well as in working with people of the business community through several education-business partnerships. With this diverse background, I understand the time and schedule constraints when trying to arrange interviews with individuals in many occupations, with these Whiz Kids who are now professionals in their own right. I have found that people are usually willing to discuss their experiences with trusted individuals when given an opportunity to do so.

Because I understand the language of the club and its multi-faceted components, conversations of that shared reality flowed easily with the members, filled with laughs and giggles over those silly costumes or the bus rides. These conversations were not stilted as they might have been with a researcher who was not familiar with this particular science extracurricular club, the characters and their costumes, the performances, and the specific science demonstrations (i.e., “the thing that bobs”, “the round globe thing”, “the trashcan demo”, “the hair trick”, etc.).

There is a possibility that participants were not honest or open with me in these interviews. However, it is more likely that the time, distance, current responsibilities, and scheduling difficulties made it easier for former members to simply ignore or decline the invitation, rather than to take the time to arrange to be interviewed when they only intended to give false information. All members were told that the club was the focus of my dissertation with no reference to it as being a “good” club or a “bad” club, since I was only interested in how future clubs might use the concepts. They all knew that I was the sponsor of the club, though, so they may still have been reluctant to say things that they think would offend me or show the club in a poor light. As stated earlier, all efforts to contact members were recorded as to who accepted and who did not accept to see if there was any factor associated with nonparticipation. No factors were identified. It is also highly possible that electronic messages were deleted in error before reading them or did not reach the intended participant due to changes in internet providers.

Surveys

With a potentially large sample size based on records that are ten to twenty-five years old, electronic surveys appeared to be the most realistic, fruitful, user-friendly and the most manageable method in collecting data. Following Wolcott’s (1994) “finish-to-start” (p. 404) approach to research, decisions were made in advance as to what and how observations should be made and represented (surveys and personal interviews) as well as in what depth (club records, artifacts, recorded experiences and memories). Preliminary data collection in a pilot study suggested new information and categories, indicating that theoretical saturation might not be reached, so the survey was modified. Changing a survey in the middle of a study would have been digitally impossible and would have altered the credibility of the final data, so the data from the pilot study was not used again. Additional interviews could be conducted to collect further samples until saturation or redundancy occurred in the data (Merriam, 1998; Shank, 2006; Strauss & Corbin, 1998a) and the categorical relationships seemed stable (Gall, Gall, & Borg, 2007).

In addition to collecting memories and perceptions of the members, the survey also contained questions regarding general demographics, such as high school attended, year of graduation, current employment, educational training or career preparation, and any volunteer work. Some measure of scientific attitudes was also sought. However, after reviewing 150 peer-reviewed articles regarding 66 instruments on scientific attitudes, Blalock, Lichtenstein, Owen, Pruski, Marshall, and Toepperwein (2008) group these instruments into categories based on how the different terms are defined (attitudes toward science, scientific attitudes, nature of science, scientific career interests, etc.) and conclude that most instruments are single study uses with no psychometric evidence. They state that there are very few instruments with the necessary psychometric evidence to merit recommendation for use (p. 961).

Without the benefit of professional consensus or recommendation, a composite of frequently used terms for scientific attitudes was added to the survey. Respondents were asked to use a self-ranking scalar (a scale of 1 to 5 where 1 means the characteristic is seldom evident in them and 5 means the characteristic is consistently evident in them) for various descriptors. These are similar to those attitudes listed by Kansas State University Biology Department and posted as “Twenty Science Attitudes” (1990) in the *Rational Inquirer*, and by Sid Womack (1999) at Arkansas Tech University, professor of educational curriculum and instruction. Survey questions are provided in Appendix D. To provide triangulation or convergent validation for the study, as recommended by Berg (2004), the third and final data for this study was the archival club records and sponsor documentation.

Survey respondents (see Table 3) included 67% graduates from School A and

33% graduates from School B. Respondents are 66% females and 34% males, with 83% Caucasians and 17% non-Caucasians. Longevity reports verify that 36% of the respondents belonged to the club for one year, 57% of the respondents were members for two years, and 8% of the respondents belonged for three years. Thus, the survey respondents, albeit a biased sample according to Rosenthal and Rosnow (1975), approximate the overall composition of the club population with respect to school, gender and race, but represent a higher percentage of longevity memberships.

For the online survey, the average number of respondents answering each question was 90 members (98%) with 2.6% of the questions left blank. The lowest response rate was for the last question on the survey that asked if they had any additional remarks for the study (58% offered comments). The average rate of responding was 97%. Considering that the survey was asking them to describe events or feelings anywhere from ten to twenty-five years after their participation, their recall, or lack thereof, is understandable. Six percent of the questions were answered with "I do not/cannot remember" or "I do not/cannot recall." Some respondents seemed upset that they could not remember; 16 (17%) apologized, 2 (2%) wrote in all caps, etc.:

- To tell the truth, it's all a virtual blur to me now. (75)
- Honestly, I can't remember! (17)
- Again, much of it is lost. (24)
- This is so sad, but I can't remember what I did. (27)
- I DON'T REMEMBER (51)
- I feel so bad that 14 years later I remember so little. (56)

Respondent comments are reported exactly as recorded on the online survey. No attempt has been made to correct any response so that the reading flow will not be interrupted by the continuous insertion of *(sic)*. Considering their high educational achievements, it is surprising that the comments from respondents on the online survey contain many grammatical and spelling errors. The initial questions asked the former members to recall events from their high school days (10-25 years ago) and their writing looks and sounds like the responses that high school students typically give. As the questions probed deeper and required more evaluation and analytical thinking, their responses became more polished with smoother transitions, better spelling and grammar. Some of the earlier questions covering club details were skipped or finished with a quick, "I don't remember" response, but value-added questions toward the last half of the survey had higher response rates, e.g., reasons for joining the club, liked best about the club, impact of costumes, impact on high school experience, etc.

Interviews

This study employed interviews as the most appropriate qualitative research vehicle, patterned after a methodology rationale by Kohlbacher (2005). "How" and "What" questions were asked with the focus of a retrospective study based on memory constructions. Following guidelines offered by Gall, Gall, and Borg (2007) and Merriam (1998), this study focused exclusively on the members, their previous participation in "Suzy Science and the Whiz Kids©," and their perceptions, interactions and memories, their reconstructed realities within this extracurricular science club. Berg (2004) justifies qualitative research for its vibrant capacity to incorporate as well as to "share the understandings and perceptions of the participants and to explore how people structure and give meaning to their daily lives" (p. 7). Interviews collected verbal data, which Flick (2006) maintains, is one of the major methodological approaches in qualitative research. Ten interviews would have been an adequate qualitative sample size, according to Gall, Gall, and Borg's (2007) guidelines, based on the "type of research, the level of significance, directionality and effect size" (p. 145), although Guest, Bunce, and Johnson (2006) find that there is little conformity in or definition of the correct sample size to meet theoretical saturation. My preference was for twenty, but I settled for eighteen interviews, based on those members I was able to locate. Quota sampling was used to finalize the selection of respondents for interviewing in order to represent the relative composition of the club membership with respect to school, gender, longevity in the club, and race.

Following Berg's (2004) and Flick's (2006) recommendations, both the surveys and interviews were designed to flow from general questions of demographics and on overall club activities and gradually lead to the essential questions regarding specific personal and evaluative memories and concerns. Adhering to the purpose of this study, questions focused on those aspects of their memories of club experiences that related to the three components of engagement and the positioning experienced within the club. Suggestions from Berg (2004), Gall, Gall, and Borg (2007), and Merriam (1998) on how to construct and frame good questions were used to develop the questions used in the survey and interviews. These included: begin with general, non-threatening questions; organize questions into some logical sequence; make transitional statements between sections; avoid generic terms with no specific meaning (several, most, etc.); avoid negatively stated items; avoid double-barreled questions that include two separate concepts; avoid leading questions; keep things as short as possible; and include brief, clear directions.

Following suggestions from Flick (2006) and Merriam (1998), questions were structured to be general enough so interviewees could introduce new topics of their own in their responses. Interview questions are provided in Appendix E. Guidelines for conducting the actual interviews incorporated the "Ten Commandments for Interviewing" from Berg (2004, p. 111), like chat before interviewing, dress appropriately, probe monosyllabic answers, and be cordial, respectful and appreciative. Of particular importance for reliability was giving consistent directions and instructions to each participant. Trustworthiness of the study was enhanced by assuring participants that all responses, good or bad, were welcomed and accepted.

Of the interviewees, (see Table 3) 72% were from School A and 28% were from School B. Females comprised 67% and males comprised 33% of those interviewed. Interviewees were 94% Caucasians and 6% non-Caucasians. Five (28%) were members of the club for three years, six (33%) were members of the club for two years and seven (39%) were members for one year. Thus, the interviewees are similar to the overall club composition with respect to school and gender, but differ somewhat in longevity and race.

Procedures

The University regulatory and compliance policies on human research as well as federal and state laws on any human research as mandated by the National Research Act (Public Law 93-348) and implemented by Federal Regulations (45 CFR 46) were observed prior to beginning this study. This means that certification by the National Institute of Health was obtained, as well as study approval and survey modifications by the Institutional Review Board (IRB) through the Office for Research Administration. Information letters and consent forms incorporated the IRB protocol number. Guidelines from ORA were used in the information letter construction (see sample in Appendix B).

Survey Format

Former club members were contacted by e-mail to complete a survey with the option to complete a hard copy of the survey or an online version. Research participants who indicated on a separate form their interest to be interviewed were also invited to participate in an in-depth interview in person, or by telephone if out of state. By choosing to respond to the survey by return mail, e-mail, online completion, or to participate in the interviews, the participants were consenting to participate and have their responses included in the study. No real names are used. Although Hadjistavropoulos and Smythe (2001) suggest that researchers use process consent, or consent as an ongoing process, only one consent was requested in this study.

To corroborate the clarity of the directions and the questions and to determine the amount of time needed to complete it, a pilot study, as recommended by Mayring (2000), was conducted with three non-member, other-club participants of comparable ages. Pilot studies implemented with this survey instrument prior to the actual study were used to identify threatening questions, difficulties, confusion, and/or errors, in a manner suggested by Bradburn, Sudman, et al (1981). Additional questions were added with IRB addendum approval.

The online survey instrument was digitally posted and completed on Flashlight, a web-based survey program, provided by the Center for Teaching, Learning and Technology at Washington State University and accessed through their secure website, http://ctlsilhouette.ctlt.wsu.edu/ctlsilhouette2_5//. This is an online system with 128-bit secure sockets layer web security and in compliance with IRB guidelines. In the absence of a signed consent form, the affirmative responses and completed surveys served the purpose of implying consent, since the nature of the study, its potential risks and benefits were provided to each member in advance (Berg, 2004). Hessler, Downing, Beltz, Pelliccio, Powell, and Vale (2003) warn that although e-mail is convenient, there are many ethical and confidentiality issues related to its use for data collection. Confidentiality for these participants has been maintained by password-restricted access to survey results and by the removal of all identifying elements. Responses to the online surveys were downloaded to the same separate hard drive for processing and filing, as were the interview transcripts. Information has been kept under lock and key and when results of the research are published or discussed at conferences, no identifying information will be included. Only those photographs or images in which all individuals have given their consent have been used but without identifiers. Quantitative data was analyzed following standard statistical processes, as outlined by Salkind (2005), namely, bivariate correlations, linear regressions, distribution graphs, and scatter plots.

Interview Format

Surveys collect extensive data quickly, but lack the personal details that one says or feels, rather than writes in a 200 character text box or 3-line blank. To allow for more subjective, situational, and emotional nature of these memories, interviews were conducted. E-mails contained separate forms to be completed by those interested in participating in an interview as well as those club members selected for interviews in order to correspond to similar proportions within the club membership. As stated previously, time, distance, current responsibilities, and scheduling difficulties limited the club members available for interviews. The purpose of the study was consistently explained to each participant and a time and place was arranged for the interview to take place with each participant. Member convenience, preference and privacy were given priority. Characteristic of most qualitative research, as described by Kirk and Miller (1986) and Merriam (1998), the researcher physically goes to various locations to interview members in their natural setting. Based on member preference, interviews were conducted in private homes, classrooms, offices of the members or the researcher, during summer holidays, evenings after work, or working lunches. Interviews were conducted and recorded by phone and then transcribed, if time to meet face-to-face became an issue. No other individuals were present during the interviews.

The interview length and the number of interview questions were designed to be focused, yet flexible to insure completion by all participants regardless of timeframes. Conversations were guided to encourage former members to recall what worked as well as what did not work in the club's operation. More importantly, members reflected on the effects of participation on later life choices. In addition to typical informal signals of active listening, my unique position as club sponsor allowed a pattern of reciprocation in exchanges of shared experiences that afforded me a greater level of trust and intimacy than an outside interviewer. However, Shank (2006) cautions that care must be taken to avoid disclosures that precipitate the discussion away from the memories and perspective of the interviewee. It was expected that these interviews would be relaxed, convivial exchanges between former members and their club sponsor, building on my "situational competency" as proposed by Flick (2006) and described in the previous section. Opening remarks explained that some "I don't remember" responses to the questions were expected and that they would be accepted as valid responses. Due to the time lag between my last meetings with these members, I anticipated that there would be additional conversation prior or after the interview in re-establishing former relationships with former students.

While these interviews posed no threat to the participants, there was a bias in that only those former members willing to meet with me could be interviewed and those not willing to meet with me could not be interviewed. Most individuals were also former students of mine. Several of the Whiz Kids and I still exchange Christmas cards every year and this, too, poses some bias. However, the memories of what worked or didn't work in this club for these participants are the essence of what made the club so special for them that they would be willing to meet with me ten to twenty-five years later to discuss their experiences. The persistence of this essence is also indicative of the level of engagement and new positioning crucial to that sought for other science ECA. The most common approach for mixed methods studies, according to Creswell (2003), triangulation was also used. The memories of different members, including pictures, club records and letters that they supplied as well as my memories and archival club records were used to assess the degree to which the participants were willing to be honest and straightforward in their responses to their club sponsor.

During in-depth interviews, in person or by telephone, an audio recording device was used. All participants were notified prior to the interviews regarding the presence and operation of the recording device and were given the option to not be recorded during the interview or to choose to have the device turned off during portions of the interview. These audio tapes were transcribed using an audio recorder with digital capabilities. Audiotaping recorded verbal messages of the interviews although the emotive or nonverbal functioning and the paratactic information (postures, distance, body language) was lost, as stated by Shank (2006). Some of these losses were minimized by using persuasive words to get participants to put their reactions into verbal expressions, e.g., "So you were surprised when that happened?" and "Did that bother you when that happened?" Words in all capital letters or italics were used to provide emphasis by the interviewee as well as some descriptors of their physical actions, e.g., laughs, giggles, squints, etc.

Measures were taken to encourage member participation, comfort and freedom to discuss their high school experiences. Attention to suitable private location for the interviews, clarification of the purpose of the interview study, the audio-taping privilege, and confidentiality consent were discussed before each interview. Though members did not express concern, the attention and sensitivity to these matters affirmed my sincerity and trustworthiness in establishing mutual respect for the special relationship in order to further understand the phenomena experienced many years ago. Following Gall, Gall, and Borg's (2007) recommendation, the rigor of this study was also substantiated by "member checking" (p. 475), or having participants review the transcripts of their statements for accuracy and completeness. None of the participants indicated any errors or adjustments were needed to their transcripts.

Data Analysis Processes

The first step in preparing the data for analysis was the task of physically transcribing the verbal data from the interviews. McLellan, MacQueen, and Neidig's (2003) suggestions about transcribing verbal data were used whenever possible in completing the interviews for this study. This means that, as much as possible, the transcription strove to keep the basic word forms and punctuation of the interviews with no reductions, reflecting the actual speech patterns and phraseology of the interviewees. Incomplete or run-on sentences were typed as they were spoken. To avoid misinterpreting physical cues by individuals who have undergone several years maturation since I last saw them, no efforts was made to include speech elisions (except perhaps, a few laughs), facial gestures, hand signals, or body language that may indicate other interpretations to the responses. All transcripts were formatted uniformly, using the same word processor on one computer. Each interview transcript included a codename, a brief introduction, factual descriptors of the interview participant, and some relevant characteristics. The researcher's questions were shown in bold font to separate this voice from those of the participants. All changes in speakers were noted in the left margin with initials in bold font. Items in italics or all capital letters signaled words spoken more emphatically or forceful speech used by the participants while being interviewed. Line numbering was added to all transcripts for ease in coding, discussion and retrieval. Digital transcripts of all interviews, once finalized and printed, were stored on a separate external hard drive that was password protected, and accessed only by one personal computer. Hard copies were stored in a locked file cabinet in a secured room.

MacLean, Meyer, and Estable (2004) suggest other possible transcription errors. These errors are related to the use of voice recognition systems, emotionally loaded audio-taped material, class or cultural differences among the parties involved, and some errors that arise when working in a second language. These sources of errors in transcription were not anticipated, nor did they occur. Common pitfalls (and possible solutions), as reported by Easton, McComish, and Greenberg (2000) were anticipated, such as equipment failure (I carried extra batteries at interviews) or environmental interruptions, like telephone calls or doorbells (I scheduled visits well in advance and avoided end of school day or peak work times). With careful planning, these pitfalls were nearly all avoided. One interview that took place on a back porch was difficult to transcribe because a bird was loudly chirping through most of the interview. I had not noticed the bird at all during the interview or would have asked to move our discussion indoors. We were really having a great time reminiscing and focused on our own conversation. In reading the transcript with several lines saying that a bird is chirping loudly now, the former member admitted that she had not heard any bird. Some of the transcription errors Easton, McComish, and Greenberg (2000) describe may still have occurred in this study, due to human error and other unknown sources.

Tashakkori and Teddlie (1998) urge that analyses procedures must be clearly explained in mixed methods studies, and that frequently the analyses occur *within* the quantitative and the qualitative approaches as well as *between* the two data approaches. They suggest various types of analyses, such as data transformation, outliers and multiple levels. After transcribing the data, the next step in this study was then to code the data for analysis. Tesch (1990) advocates the use of word processors to analyze and display data and offers three approaches in analyzing case study data: interpretational analysis, structural analysis and reflective analysis. In this study, interpretational analysis was used to describe and find patterns or constructs by compiling the data, identifying categories that adequately encompass and summarize the data, and then encoding the data.

Several studies offer other suggestions on the most effective strategies to use. Kohlbacher (2005) urges researchers to examine the data by putting the responses into the various categories and then organizing them into key themes and seeing how well they fit into the expected categories. He also proposes content analysis as a quantitative procedure, one that concentrates on the quantifiable aspects of the text content and focuses on the relative frequencies of words per category. This method gave me an initial starting point. Mayring (2000) also delineates a systematic, rule-based content analysis, using categories as the center of the analysis. To do an analysis, Babbie (2001) states that verbal communication data should be coded or transformed into some standardized form. For this study, all data was coded, tabulated and entered on a Microsoft Excel spreadsheet to begin the data analysis purposes. Formulas were built into summary cells to tally results as well as to check accuracy in reporting through vertical and horizontal checks. After coding the data, the results were evaluated for themes and then from the themes, concept composites were determined. For example, all responses for the participants were coded by categories according to the coding schema (see Appendix F). Some responses included codes from more than one category or sub-category. For example, all the codes that dealt with behavioral engagement would then be tallied by sub-categories and then combined to reveal a composite score for behavioral engagement. The analysis examined individual outlier cases to assess how the themes supported these meanings.

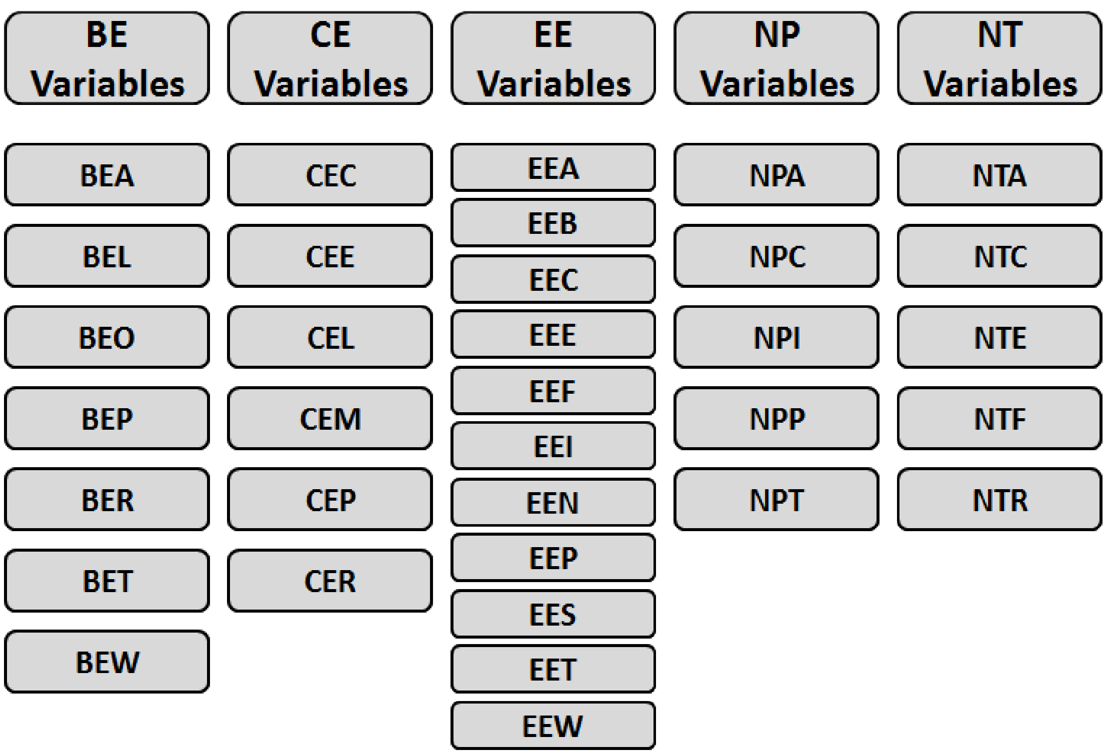
Ryan and Bernard (2000) caution that “coding forces the researcher to make judgments about the meanings of contiguous blocks” but it is the “heart and soul” (p. 780) of text analysis. Judgments made in coding the transcripts depend on the experiences and perceptions as well as the technical and interpretative skills of the researcher and may not accurately reflect the realities presented by the participants. According to Peshkin (2000), the “essence of case study is interpretation, because the researcher's interpretative acts give importance, order and form to the study" (p. 454). This is based on the researcher's judgment on what to collect, where to find it, and how to describe it to affirm results and shape the meaning and understanding that occur.

The data collection coding followed a similar process to that outlined by Strauss and Corbin (1998b). The data was initially categorized and coded (open coding) and then examined to see what patterns emerge, then to see if these members gave voice to the same qualities or characteristics when describing their experiences and memories. The coding schema (see Appendix F) addressed the dominant categories and their subgroups (axial coding) for patterns or characteristics (selective coding). Any transitional comments, such as "That's a good one," "Hmmmm," or "Let me think" were not included in the analysis. In scrutinizing the transcripts, several additional themes began to emerge. The coding schema was refined to incorporate these new themes.

An inter-rater reliability examination of the coding schema was conducted with three non-participants. During the four-hour session, the initial schema was explained and handouts with 200 samples from the data collected were presented for coding. After coding the first page of samples, all four raters presented their coding for each sample and discussions followed as to why each code was selected. Several of the codes were clarified and all raters recorded the changes on their schema. The next page of samples were coded and once again, raters checked how well their codes matched the others, with justifying discussions. Thus the cycle continued. It took five pages of samples until consistent matches occurred. The resulting schema is shown in Appendix F. The raters stopped working and I took them to dinner.

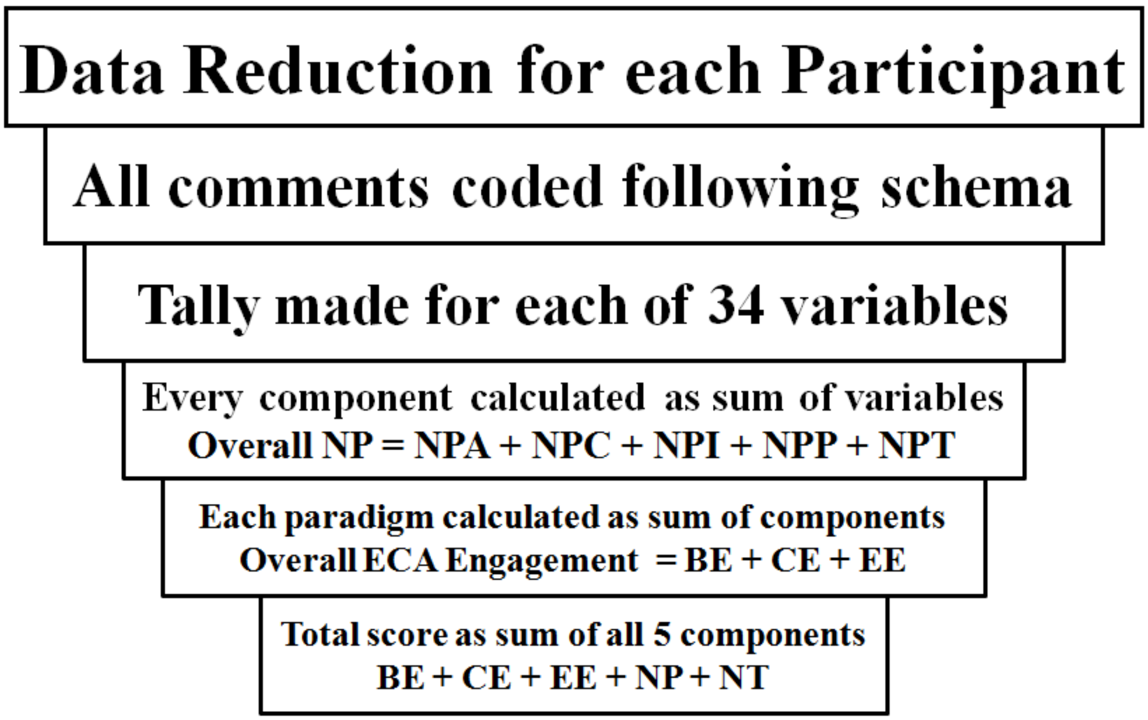
Using the coding schema (see Appendix F, Figures 1 and 2), survey responses were coded for the content and evidences identified in the statements and then tallied to give survey respondents a score for each variable of behavioral engagement. Some responses incorporated multiple themes and were coded using all the respective codes. The frequency of each code occurrence was tabulated for each code and for each participant. Each participant's individual frequency counts were grouped by major topics, that is, the frequency counts for all codes within the category of behavioral engagement were totaled to produce an overall BE score, etc. The phrase, overall ECA engagement, represents the

Figure 1. Variables within the Coding Schema



overall club engagement of the former members in Suzy Science and the Whiz Kids©, as determined by the algebraic sum of the individual engagement scores (BE + CE + EE). The phrase, overall identity formation, represents the overall identity formation of the former members in Suzy Science and the Whiz Kids©, as determined by the algebraic sum of the individual identity scores (NP + NT). Frequency counts do not necessarily represent the most important memories or the entire or actual reality or in the data collected, just as the absence or low frequency of comments does not indicate the lack or unimportance of a memory. Using a mixed methods, this study is specifically designed

Figure 2. Interpretative Data Reduction Representation



to share both the most frequently-occurring as well as the individual insightful comments so that a closer representation of the reality may be better depicted. All correlation and regression analyses were performed with a computer software program using individual frequency counts and composite scores. While computer software may be the most appropriate method in handling large amounts of quantitative data, the thick descriptions in the qualitative data allow for a more complete interpretation of the reality according to the members.

Representative quotes have been selected to illustrate data interpretations. Efforts have been made to balance the quotes chosen for inclusion about engagement in order to insure that all of the voices are heard and that none dominated the inquiry. The average number of quotes on engagement used per participant is 6, with a range of 1 to 12 quotes. The median of quotes is 6 per participant. The same efforts have also been made to balance the quotes chosen for inclusion about identity and positioning. The average number of identity quotes used per participant is 3, with a range of 1 to 6 quotes. The median for quotes is 2 per participant. Those who were in the club longer or who held leadership positions tended to have more to say and information to share that was more appropriate to be included in this section than did those members who were in the club for only one year and/or did not hold a leadership position. Comments reflect longevity and leadership predominance among members. Efforts have been taken to insure that comments from respondents provided in each section are different from those referenced in others, but some duplication may have inadvertently occurred.

The final step in data analysis was verification, to check a study for its accuracy (retracing the steps or thought processes by which the conclusions were derived) and reproducibility (clearly articulating the procedural steps so that other researchers could reproduce the study and its results) (Berg, 2004). In qualitative research, the observations and intuitive understandings gained in the field is used inductively to build a theory that explains the phenomena (Merriam, 1998), or was used in this case to describe the characteristics of effective science ECAs. Following the data analysis and summary and using the Joint Committee on Standards for Educational Evaluation's Criteria for Effective Evaluation (Gall, Gall, & Borg, 2007), an evaluation of the utility, feasibility, propriety and accuracy of the study was conducted.

Ethics Involved

An analysis of the ethical ramifications for this study appears to meet the guidelines for good qualitative research (Flinders, 1992). While it is generally difficult to predict the consequences of a study, the reflection by the club members in this particular study on “Suzy Science and the Whiz Kids©” only tended to reinforce those actions and perceptions which they had already experienced. The benefits and risks of the study were explained to former club members prior to participating in the study and informed consent was requested before proceeding. I made deliberate efforts to treat each participant honestly, equitably, and respectfully including assuring their responses were confidential and anonymous within the study. With the club’s extensive years of operation, many individuals have been impacted by its presentations and activities. Sensitivity to the disclosures by the participants refined the analyses of the results of this study, as advocated by Ryen (2004) in her plea for non-maleficence, to do no harm. As the creator and sponsor of the club, I have always tried and will continue to try to demonstrate a caring, sensitive attitude toward participants, as in previous timeframes.

Decisions regarding the participants’ school culture and contributions will be directed toward the improvement of science education for the larger social system. The study demonstrates Flinders’ (1992) four good research ethics, including utilitarian ethics (the greatest good for the greatest number of people), deontological ethics (absolute values as standards of conduct), relational ethics (moral member of the community), and ecological ethics (the good of the larger social system).

Limitations to the Study Design

Limitations to the design chosen developed from several sources - people, time and the methodology itself. The researcher's background and experiences posed certain limitations that could impact the findings. Time and location constraints to meet with former club members, who are now gainfully employed posed some obstacles. For example, a nurse on the graveyard shift had to be interviewed after her rotation was completed. Although I might have anticipated meanings or inferred events differently than as they were presented in the interviews, the effect of the previous personal relationships between members and sponsor and the process of sharing these positive, reflected memories more than likely enhanced the communication flow and authenticity. The value placed on the personal interactions and relationship between students and sponsor cannot be underestimated and would make it difficult for a researcher outside those interactions and shared memories to fully comprehend the conversations and the meanings behind them. The trust built into these relationships has taken years to cultivate and an outside researcher would have to be knowledgeable in science ECAs and skilled in rapport building and interviewing to conduct comparable interviews using this instrument and to expect similar results.

Preconceived notions or perceptions about specific members and their contributions to or engagement in the club based on personal observations may have altered, or influenced the interview conversations. The relative positions between sponsor and member may have impacted how comfortable and open members felt in discussing these matters, although there is no longer any possible repercussions for them from errors that occurred in the past. That is, they cannot be sent to the principal's office for detention, they will not be asked to resign from the club, nor will their spouses or employers be informed of any errors or lapses in judgment. The relaxed comfort level was based on the trust and respect from the original interactions and engagement of students and sponsor and on the professional manner in which the present interviews were conducted. Letters requesting interviews explained and pre-interview conversations reiterated that participants could decline or stop the interview at any point at which they felt uncomfortable in continuing. Personal fears or uncertainties about one's own effectiveness may have altered or suppressed the interviewee's responses or the researcher's perceptions of their answers. The researcher's skill in interviewing may have adversely affected the outcomes of the interviews.

Some limitations might have originated in the choice of individuals who were available but did not necessarily embody the full measure of participation and engagement typical of the club's members. Some limitations may have come from the members themselves. It has been several years since they have given presentations. These former members were told prior to the interview that it was permissible and to not feel embarrassed if they said that they do not remember. All comments, good or bad were welcomed and accepted. These former Whiz Kids were also asked to bring, if they had any, pictures or memorabilia from the club that they might be willing to share for purpose of the study. Eager to participate, they may have inadvertently embellished weak memories in order to be able to provide answers, but the emotional, or feeling tone surrounding the remembered experiences was authentic and we enjoyed laughing at some of the funny stories we remembered together. They may have had their own agendas to follow, instead of responding to the questions posed. None of the members lingered on personal matters, instead of the ones regarding the club experiences. After the interviews, several former Whiz Kids shared concerns of a personal nature and still valued my opinions and sought my advice. I challenged two to rise to the challenges before them, just as I had seen them do years ago.

A major limitation of this study was time. Time constraints affect us all and I regret that I could not locate all of the former Whiz Kids despite the time invested in the process. Time constraints were not only those of my time to conduct each interview, but also those of the interviewees. As stated earlier, moving, critically ill births, international travel and submarine duties permitted no time for me to meet with some former members. Members granted time to meet for the interviews, valuable time that was challenged by young children, pets, older adults, parents, significant others, employees or employers. Once interview time became available, there appeared to be ample time to complete the interview to the satisfaction of both parties, with no perceived restriction as to the extent or depth of questions that can be asked and completed by all interviewees.

The limitations of interview methodology resides in the interpretation skills of the researcher who, although sincere and diligent, is still human. Gall, Gall, and Borg (2007) state that the researcher actually becomes the "measuring instrument", as she carries out the data collection, becoming personally involved while interacting with the research participants, and using "empathy and other psychological processes to grasp the meaning of the phenomenon as experienced by the individuals in the setting" (p. 458). They warn that these procedures cannot be standardized or specified in advance of data collection.

A thorough case study investigation is also limited for this study by the lack of multiple sources of evidences from the *experts*, in that only their taped retrospective interviews and/or surveys were available for this study. The data was self-reported, but some information could be checked against club records. Many members even suggested that I check the club records for some information because with the passage of time, they had forgotten certain details about their involvement, e.g. character name, years in the club, etc. Narratives generate identification links for individuals to specific interactions, according to Watson (2006), based on “situated reliability”, but which may lead outside readers to consider researchers as “unreliable narrators” (p. 367). Watson (2006) contends that contradictory data may initially cause surprise, but will hopefully lead to reflection on the meaning behind these inconsistencies. Additional documentation, such as videos taken of their original presentations or current presentations by former members would have further supported their reflections. Archival club records and sponsor documentation provided the final evidence on which to base the study’s findings. Although care was taken to insure interviews of comparable percentages that reflect the overall club’s composition with respect to school, gender, longevity and race, the changing membership configuration of the club from one year to the next made the use of averages an acceptable approximation.

The final limitation in this study is the methodology itself. Using memories to study a phenomenon was first addressed by means of definition. While memory is colloquially associated with nostalgia or as only being a collection or re-telling of events, a rigorous qualitative study represents a systematic triangulation of people, events, their meanings and ideas that have shaped and influenced the present. Memories, while not reflecting reality, still indicate the process of sense-making as individuals interpreted actions and behaviors and ascribed meaning to them. Qualitative studies using memories thus provide a broad perspective of human behavior and thought. The goal is understanding and illumination, not causal inferences. Berg (2004) defines the purpose of qualitative research as trying to discover answers to questions through a systematic set of procedures and by examining the social settings and the individuals in those settings, investigators can discover “how people arrange themselves and how individuals make sense of their surroundings through symbols, rituals, social structures and social roles” (p. 7). Simply, what people do and say is the result of how they have interpreted their social world. Thomas and Swaine (1928) state it this way: “It is not important whether or not their interpretations are correct. If men define situations as real, they are real in their consequences” (p. 572). Just as meaning is conferred on objects and events, then the memories of former club members reveal how they interpret and make sense of what they have experienced and that perception is what reality of the club is to them. “Perception is reality” is a quote attributed to many but quoted by many more. Shank (2006) extends this further, saying that these beliefs about the way things happened are the fundamental ways we operate in the empirical world. Although subjective and personal, these beliefs shape who the individuals are and allow them to go confidently into the world as if those beliefs actually are real. In collecting and analyzing memories, these perceived realities, Shank (2006) issues the phenomenological challenge to “interpret these beliefs without creating new realities, without imposing the researcher’s perceived reality, and without making the results of the research align with self-imposed dictates” (p. 83) . To understand the behaviors of people, researchers must first understand the definitions, meanings and processes by which they are formed and accurately record observations, all the while realizing that the memories of the researcher affect the analysis as well.

Trustworthiness of Data

Reliability, validity and generalizability of this study are critical issues in any research undertaking. Reliability deals with the accuracy of research. First, the reliability reflects the accuracy of the study - whether the data collected is accurate. Would others conducting the same study get the same results? The accuracy of this study parallels that of any qualitative study dealing with people, their memories of distant past events, and the meanings they have ascribed to them. However, whether their responses are identical to the ones given in this study, the basic precepts of qualitative inquiry focus on the over-arching themes and holistic situatedness of the responses, rather than those of any single individual. It is highly likely that interviewing another fifteen former members would yield similar findings. From that perspective, this study is reliable in that records are accurately scrutinized and maintained, coding schemas are consistently applied, and triangulation efforts are methodically used.

Secondly, reliability will be established through consistency, cohesion and confirmability in data collection (uniformity of question presentation and requests for clarification of responses) and analysis (standardization in coding according to detailed schema) (Shank, 2006). Taylor and Chiogioji (1988) urge researchers to clearly define critical terms, to provide sufficient details within literature reviews, and to build cohesion throughout a study in order to improve reliability. Reliability also depends on trustworthiness. The receptivity of the former club members to participate in this study also depicted the initial trustworthiness established between students and sponsor years ago and the trustworthiness they accord to me now in faithfully recording and reporting their responses. Trustworthiness is also established by focusing on processes of verification during the research rather than waiting until the end of the study to evaluate results (Morse, Barnett, Mayan, Olsen, & Spiers, 2002).

Transferability, or the degree to which the results can be transferred to another setting, is initially evident by the implementation and operation of the program in two different school settings (one large public high school and one small private high school) and the implementation of the club in a third medium-sized public high school by a former member who became a chemistry teacher herself. Reliability and credibility, or believability are advanced in this study through triangulation with the use of multiple data sources, namely, interviews, surveys and club records and documentation. Member checking of data collected enhances dependability, a corollary of reliability, for this study. Dependability, credibility, transferability and confirmability attest to the trust-worthiness (Morse, Barnett, Mayan, Olsen, & Spiers, 2002; Shank, 2006) of this study.

With the changing nature of reality and social interactions, individual responses will vary, but these unique responses will be to the consistently presented procedures and instrumentation that will allow me to unpack the essential elements of this science ECA in the eyes of these participants. Other measures of these ECA influences might also be available that would lend further insights into the multiple interpretations of the participants' realities. The procedural and analysis processes have been clearly articulated for verification and reliability and in the hope that others will choose to examine and then implement the theoretical model derived from this study.

In addition to reliability, validity is important for this study. Validity deals with the truth, of what happened and what is reported as actually happening. The job of the researcher-observer in this study is to be transparent and observe only those things that are really there. The validity in qualitative research is primarily in the clarity of the researcher's perspective, or etic, so observations made by the researcher can more effectively be assessed to determine if I correctly reported their understandings and perceptions. Member checks of the information collected are very helpful with the truth of the study initially verified by the clarity of my perspective as the original creator and sponsor of this science ECA. What I have observed/experienced and what others say they have observed/experienced is the reality in which we interacted. The actual reality may lie somewhere in between these shared interpretations, but the composite of these multiple realities defines authentic understandings and concepts that can be forged together to form a theoretical framework of what constitutes an effective science ECA.

Morse, Barnett, Mayan, Olsen, and Spiers (2002) seek to link analytic modes of induction with rigorous methods for ensuring validity in qualitative fieldwork. They argue that reliability and validity are being subtly replaced by criteria and standards for evaluation of the overall significance, relevance, impact, and utility of completed research. Strategies to ensure rigor inherent in the research process itself were back-staged to these new criteria to the extent that, while they continue to be used, they are less likely to be valued or recognized as indices of rigor. Morse, et al (2002) suggest that rigor comes from identifying the quality of research and procedural decisions, the rationale behind those decisions, as well as the responsiveness and sensitivity of the investigator to data. One of the most popular validity strategies is triangulation, or using different sorts of data and data gathering strategies that then converge upon a particular finding. Clear protocols and triangulation methods in examining the science club have been used to increase the validity of this study. Combining survey responses and individual interviews along with my archival data as the club sponsor, that is, club records and other documentation provided by the Whiz Kids themselves (pictures, memorabilia, writings, journal entries, etc.) offer data triangulation to increase the validity, as advocated by Maxwell (2005).

Once again, triangulation of artifacts supports these interpretations. Hupcey (2002) stresses the importance of an adequate literature review to support validity. Reid, Kamler, Simpson, and Maclean (1996) challenge researchers to make explicit their underlying interests and agendas and the limitations due to the unique relationship between researcher and participants, and these possible biases have already been noted. Lennart (2001) warns that using narratives in research also poses the risk of over-interpretation while Spiers (2002) warns researchers to be wary of the pink elephant paradox, or the threat to inductive reasoning by misattributing data based on the researchers' preconceptions. Saturation, replication and verification reduce this latter hazard to good research.

Validity is interpreted by some researchers, not as the truth of the research as much as it is the authenticity or usefulness of the study, according to Shank (2006). The authenticity of this study is based on multiple points of view and its usefulness is aligned with the national goal of improving science education.

The final consideration is generalizability, or examining whether the sample represents a given population and if other samples would yield the same results. By looking at the typical cases and then studying the unusual cases, the researcher hopes to simplify an understanding of some phenomenon. A generalization is examined to see if it applies in a variety of situations. In qualitative research, it is often not possible to simplify things and certainly not intended to lose key aspects in a reduction process. Smaling (2002) uses the process of analogical reasoning to support cross-case generalization and builds upon simple methods of inductive generalization to develop a variety of new conceptual forms of generalization that are applicable to qualitative studies. This study involves a highly selective sample, with the results analyzed to reveal over-arching concepts and observations.

The passage of time and distance prevented the location of all members, but all full-time members located were invited to participate in the survey. Greater variety in the members chosen for interviews might have increased the validity of the study results (Gall, Gall, & Borg, 2007). However, the select nature of the sample restricts the measure of generalizability possible. Without controls of a true experimental nature, the generalizability of this study applies only to the population from which the sample was drawn, club members and not to all high school ECA populations. It is left to the reader to compare the situations, imagine the possibilities, and determine the extent, if any, for applicability of these findings to the individual situation.

Chapter Four: Results

Setting the Perspective and Lantern for the Reader

The engagement components identified by Fredricks, Blumenfeld, and Paris (2004) and the social positioning concepts reviewed in the related literature form the organizational structure for this chapter with selected respondent comments and quantitative analysis interspersed by topic. With a significant amount of data to present, some preliminary explanations and notations are needed. The name of the club, "Suzy Science and the Whiz Kids©" is abbreviated SSWK. Bracketed inserts have been added to clarify some pronouns in direct quotes. Clarifying questions asked by me while interviewing former members are shown in bracketed italics within the individual's responses. The number in parentheses after each quote refers to the actual numbered survey participant. Those numbers in parentheses that are preceded by "I" indicate interview participants. Distinguishing names and references have been changed to generic replacements shown within { } to insure the privacy of the participants. Gender issues are documented in many studies of science ECA engagement, so for corresponding topics in this study, the gender of the responding members is given in parentheses as well after quotes.

Finally, this retrospective study of SSWK has the feeling of trying to return to Lerner and Lowe's (1954) "Brigadoon," a mythical land that appears once in a lifetime and then disappears into the mists of time. Reconstructing relationships, interactions and feelings are based on memories that have mellowed, but have also grown dim with the passage of time. The previous chapter bracketed the etic perspective of this researcher and emphasizes the limitations of this study due to the obvious bias and interaction of this researcher as club sponsor and of the participating adults as former club members. The reader is charged to use the vision from the lantern (Shank, 2006) as well as the sounds and images from the small voices of yesterday's teenagers in their search for identity and significant relationships, not only within their small circle of friends, but also with peers beyond their immediate social group, with their parents and teachers, and within their school. The mists of time through which these visions and voices are transmitted may obscure some aspects, just as cataracts in old age tend to blur an image. Looking and listening for the underlying concerns, fears, dreams and values in the small voices of those teenagers lurking beneath the conversations of the adults they have become enables readers to recognize the meaningful actions and changes in perceptions that fostered the growth and development of self-identity and trajectories of identification. The collective insights gleaned from the survey responses of these 92 members along with data from the 18 interviewees will unpack the essential elements of what it meant to be a member of SSWK, a science ECA years ago and will be used to form the basis for a theoretical framework for an engaging and socially constructive science ECA.

Comparison of SSWK and Related Literature

The basic structure and operation of the ECA under investigation is first examined against the background of the literature reviewed. The literature reviewed presents results of more contemporaneous, albeit many self-report-based studies while this study deals only in memories and archival records. Decisions made early in its creation were based on years of experience in working with teenagers, yet are comparable to the findings of many related studies completed after its implementation.

The concepts of teenagers dressed in costumes teaching young children came from Children's Church, a large group of students working collectively in small squads came from Girl Scout squads, and a hands-on approach came from a 7-year-old child wanting more hands-on activities in her school science class. It has been very rewarding to find that many of its precepts have been validated by subsequent research studies. The challenge will be to distill the essential elements and use them to design a theoretical framework for an engaging and social constructive science ECA.

Suzy Science and the Whiz Kids© (SSWK) was a science ECA that operated for 14 years, ten years at a large public high school and four years at a small, private high school. Students had the opportunity to enlist in this club for one to three years based on the grade level at which they took chemistry. Many high school seniors populated the club (Darling, Caldwell & Smith, 2005) which may be explained by the need for resume building (Guest & Schneider, 2003; Swanson, 2002). However, students not working jobs or taking advanced level classes may find at the end of their high school career (e.g. math requirements have ended) that they have more time for ECA participation. Of the 352 participants in SSWK, 80% remained members for the maximum number of years possible, based on the grade level at which they first joined the club. Their longevity increases the benefits of ECA participation (Barber, Eccles & Stone, 2001; Darling, Caldwell & Smith, 2005; Olszewski-Kubilius & Seon-Young, 2004; Posner & Vandell, 1999; Simpkins, Ripke, Huston & Eccles, 2005).

Through the years, club membership expanded and no one was turned away because they could not afford a costume, demonstrating the elasticity and flexibility usually not found in large high schools (Crosnoe, Johnson & Elder, 2004; Morgan & Alwin, 1980). The sponsor also actively recruited some students for the club (Guest & Schneider, 2003; McNeal, 1999). Reasons for enlisting these students included their poor self-esteem and underachievement in science (Everson & Millsap, 2004; Mahoney, Cairns, & Farmer, 2003; Marsh & Kleitman, 2002; Olszewski-Kubilius & Seon-Young, 2004; Powell (2004); Reis, Colbert, & Hebert, 2005). Students were also encouraged to join in the hopes of developing their aptitude or potential for leadership, science, teaching and human potentials (Silliker & Quirk, 1997).

Students chose from a variety of colorful, cheery costumes and applied make-up to assume a new identity (Bakhtin, 1965d). The costumes encouraged a useful role-play that positioned them to become the science ‘expert’ for the elementary school children. During role-playing, students had the opportunity to explore new identities and test the ‘fit’ of the values of that identity, in this case, identities in science and teaching (Currie, 1991; Darling, Caldwell & Smith, 2005; Eckert, 1989; Guest & Schneider, 2003; Pinciotti, 1993; Powell, 2004; Rounds, 2006, albeit not in the virtual worlds advocated by Appelman, 2005 and Dickey, 2003).

Students prepared their demonstrations with the teacher in small squads of four to six members (Campbell & Clewell, 1999; Csikzentmihalyi, 1999; Kahle & Meece, 1994; Murphy & Whitelegg, 2006; Stohr-Hunt, 1996). Working in small groups with the teacher offered them the opportunity to develop personal relationships with an adult supervisor outside the classroom (Broh, 2002; Darling, Caldwell & Smith, 2005; Holloway, 2002; Jussim & Eccles, 1992; McLaughlin & Irby, 1994; Mahoney & Stattin, 2000; McNeal, 1999; Olszewski-Kubilius & Seon-Young, 2004; Rehberg & Schaefer, 1973; Reis, Colbert & Hebert, 2005; Silliker & Quirk, 1997).

Whiz Kids learned to present demonstrations skillfully to elementary school children (McCormack, 1990; Voegel, Quashnock & Heil, 2004). Whiz Kids' demonstrations were of a broad spectrum with each squad's demonstrations centered on specific physical science themes, contrary to the documented preference of girls for biological science over physical science topics (Lawton & Bordens, 1995). Although SSWK might be criticized by for its selective admission with two entry-level requirements (McNeal, 1999; Morgan & Alwin, 1980; Ostro, 2006; Pipho, 1986), other writers support ECA that stress the importance of having experienced, qualified (science) teachers as sponsors of (science) ECA to monitor and enforce science safety (Burian-Fitzgerald & Harris, 2004; Koszalka, Grabowski & Darling, 2005; Mahoney, 2000; Munro & Elsom, 2000; Wilds, 1917). This was strictly a voluntary, not a paid position for the science teacher who was the club sponsor.

Students practiced working as a group to enter and assume control of a classroom as well as to support and protect their peers from uncooperative, disruptive elementary children (Barber, Eccles & Stone, 2001; Cushman, 2006; Darling, Caldwell & Smith, 2005; Silliker & Quirk, 1997). Squad leaders were charged with keeping their squad members informed of club activities, building a social network of Whiz Kids (Barber, Eccles & Stone, 2001; Bishop, Bishop & Bishop, 2004; Darling, Caldwell & Smith, 2005; Dworkin, Larson & Hansen, 2003; Eccles & Barber, 1999; Eccles & Early, 1997; Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002; Guest & Schneider, 2003; Hanks & Eckland, 1978; McNeely, Nonnemaker & Blum, 2002). These squad leader positions offered leadership roles and responsibilities to students, particularly girls

(Dewey, 1916; Harragan, 1977; Wanlass, 2000).

The club had clear organizational guidelines (Broh, 2002; Chambers & Schreiber, 2004; Dworkin, Larson & Hansen, 2003; Guest & Schneider, 2003; Mahoney, 2000; Mahoney & Stattin, 2000; Mahoney, Stattin & Magnusson, 2001; McLaughlin & Irby, 1994; McNeal, 1999; Posner & Vandell, 1999; Reis, Colbert & Hebert, 2005; Silliker & Quirk, 1997). The teacher served as the elementary school contact, met with their faculty members, and arranged schedules and visits; PTAs and parents provided transportation and lunches, respectively; Suzy told the squad leaders who, in turn, kept their members informed of practices and performances; and high school students conducted all individual elementary classroom visits by squads.

As previously arranged with the elementary school faculty, Elementary children wrote fan mail to the Whiz Kids, or their favorite characters, describing what they learned or liked about their presentations. This 'fan mail' likely offered significant, positive reinforcement and increased self-esteem for the high school students in their roles as science teachers (Cushman, 2006; Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002; Olszewski-Kubilius & Seon-Young, 2004).

SSWK shows remarkable correlations with the studies reviewed in the related literature and thus, serves as a viable vehicle to examine in constructing a feasible theoretical framework for an engaging and socially constructive science ECA.

Engagement in Suzy Science and the Whiz Kids©

ECA engagement is based on three engagement components, namely behavioral, cognitive and emotional engagement of ECA members (Fredricks, Blumenfeld & Paris, 2004). The engagement of the participants in Suzy Science and the Whiz Kids© is examined along these same three components, based on their survey and interview responses. After coding each response, the count of every variable was totaled for a variable score for each participant. The sum of all the behavioral engagement (BE) variables was used as an overall BE score. The same procedure was sued to produce a composite score for cognitive engagement (CE) and emotional engagement (EE). The sum of the overall BE, overall CE and overall EE scores yielded an overall engagement score for each participant. All tallies were compiled in an Excel spreadsheet with cross checks to insure count accuracy.

Behavioral Engagement (BE) in SSWK: Introduction

One of the three engagement components, behavioral engagement in extracurricular activities can be evidenced by the visible behavior or actions of the students, such as 1) participating, attending functions regularly, and interacting with the teacher, 2) persistently volunteering time and effort and making contributions to a group, 3) taking leadership roles within the group, and 4) knowing and following routines and behaving appropriately. Behavioral engagement offers many benefits, such as 1) psychological adjustments, 2) a decrease in problem behaviors, and 3) life skills. An overall behavioral engagement (BE) score is calculated for each participant based on the algebraic sum of individual behavior engagement variables from their coded responses.

Behavioral Engagement in SSWK: Evidences

Attendance and Involvement. The initial evidences of behavioral engagement (BE) in SSWK include attendance and involvement. Analysis of the respondents' answers show a moderate, significant correlation between behavioral engagement and attendance and involvement (r = 0.483, ρ = 0.000), meaning that members with higher overall behavioral engagement scores were somewhat more likely to be members who

Table 4. BE Variables, Survey Response Percentages Disaggregated by School, Gender, Race, and Longevity where School: A = Public; B = Private; Gender: F = Female; M = Male; Race: C = Caucasian; NC = Non-Caucasian; and Longevity: N = Years in SSWK

Variable	School		Gender		Race		Longevity		
Values	A	B	F	M	C	NC	1 Yr.	2 Yr.	3 Yr.
Attended Every Event	56	53	57	52	58	44	31	67	71
Missed Due to ECA Conflict	0	7	2	3	1	6	6	0	0
Stated Longevity	34	27	69	48	37	6	30	75	86
Stated Character	56	37	49	52	50	50	48	46	86
Stated Demos	18	10	16	13	14	19	9	17	29
Extra Time	16	23	15	26	14	38	18	19	14
Longevity (yrs.)	2.0	1.8	2.0	1.6	2.0	2.0	36	57	8
Liked Sponsor	27	13	26	16	24	19	33	12	57
Invited to Join	16	13	11	23	14	19	18	15	0
Squad Leaders	52	37	56	29	49	38	3	58	86
Squad Cooperation	4.6	4.3	4.5	4.5	4.6	4.5	5.0	4.5	4.7

reported greater attendance and involvement. This pattern is tested against the two outlier cases. One outlier represents a member (27) who reported good attendance but only joined the last semester of her senior year, received separate training and attended only one performance at an elementary school. The second outlier represents a member (1) who left after one year to assume leadership roles in ECA sports. Thus, the data still tend to support this finding.

Of the respondents, 51 (55%) indicated that they remember attending every meeting and event; 2 (2%) attended every event except for another school conflict; 29 (32%) also indicated the number of years they were a member; additionally, 46 (50%) mentioned their character by name; 14 (15%) mentioned the demonstrations they performed (others mentioned these later in the survey); and 36 (39%) answered the question without mentioning their character, demonstrations, or longevity in the club.

Data summarized in Table 4 show respondents who were members longer reported attending more of the activities and never missing events due to other ECA conflicts. There was very little difference between longevity and time spent beyond club expectations. Those claiming to have attended every event were 31% one-year members, 67% two-year members, and 71% three-year members. Three-year members were nearly three times more likely than one-year members to identify the number of years they were members and their demonstrations, and twice as likely to identify their characters.

Large public school respondents were more likely than small private school respondents to identify their character names and demonstrations and to mention their years in the club, perhaps, signifying the importance of a distinguishing identity among the larger student population. The public school respondents never mentioned missing any events due to another ECA conflict, but 7% of the private school respondents stated that they missed an event due to another school activity.

Race had little or no impact on differences in identifying their characters or demonstrations, but non-Caucasians were six times more likely than Caucasians to report missing events due to ECA conflicts, while Caucasians were six times more likely than non-Caucasians to indicate their number of years in the club. Approximately 25% more Caucasians than non-Caucasians reported attending every event.

Former SSWK members recalled their attendance and involvement in SSWK:

- I joined in my junior year and continued as a senior. I was Dr. Dan. (91)
- I regularly attended and was involved for two years, the first year as Polly Pilgrim (working with electricity and magnetism) and the second year as Raggedy Ann (working with sound and light). (19)
- Consistent at events that occurred on weekdays and weekends from 10th grade through my senior year. (39)
- I was regularily involved with Suzy Science. I was a flapper [her character was a dancer, "Twenties Tina"], and really enjoyed myself. (59)
- I was a Ladybug & performed fiber optic demonstrations for the students. (67)
- I was there [in SSWK] briefly and for a single event. I did enjoy it but I had too much going on with theater as well. (71)
- I was there for every meeting and every event, that I can remember. I was Billy Basketball and I remember going around to the grade schools. (48)
- As far as I can remember, I don't think I ever missed a meeting and I attended all extra activities. My character was 'Emmy the Elf'. (63)
- I started my sophomore year and attented on scheduled club days as well as any after school meetings needed. I started off as Candy, the candy striper, Angie Angel and then Glenda Goodwitch. (23)
- I would consistently go to meetings and attend the outreach programs we did. I was a hershey kiss as a character and I taugh about gravity. (90)

Two respondents (2%) indicated that they did not remember any specifics and one respondent did not answer this question. For some former club members, the responses were more lackluster:

- I was involved with the program for one year. I was not involved in any of the student governance of the program and would not consider myself to have been heavily involved in the program itself. (78)
- Minimal involvement, Bonnie Butterfly. (27)

- I enjoyed Suzy Science, however, I don't remember being very involved or engaged beyond the minimal requirements. We could have been more active. (6)

Impact of Gender. Particularly in science ECA, behavioral engagement measures dealing with membership quotas generally elicit gender issues. However, in complete contradiction to the findings of Olszewski-Kubilius and Seon-Young (2004), SSWK membership averaged a gender ratio of 2:1, or 67% females to 33% males. Female and male respondents in the same proportion reported joining the club because they liked science and females averaged 2.0 years in the club while males averaged 1.6 years in SSWK (see Table 4). In sharp contrast to the findings of Lawton and Bordens (1995), Debacker and Nelson (2000), and Jones (1991) where girls chose life sciences over physical sciences, females actively participated in this science ECA where each squad was focused on a central physical science topic. These topics included electricity and magnetism, forces (gravity and mechanical forces), circular and accelerated motion, measurements, light and sound, chemistry, scientific method, and air pressure.

Gender issues, such as those regarding topic and course selections reported in other studies (Bell, 2003; Howes, 2002; Kahle, Matyas & Cho, 1985) have been singularly absent in SSWK. There is no correlation between overall behavioral engagement scores and gender ($r = 0.046$, $\rho = 0.665$), indicating that members with higher overall behavioral engagement scores were not likely to be a particular gender. At first, this finding seems counterintuitive. If the proportion of females to males in the club was 2:1, then females would be expected to have similar proportion of high overall behavioral engagement scores, which is true but not what this correlation shows. SSWK females actively participated in effectively demonstrating physical science concepts.

Females shared the following insights about their involvement in the club and in working with these scientific concepts:

- I was consistently involved in the science club, enjoyed it tremendously. (34)
- I was the character known as "Kelly Cowgirl." My experiment had to do with air pressure. I don't remember missing any engagements. (66)
- I remember having to come up with a name/character and some type of experiment. I don't remember training being overly difficult. (60)
- I recall we would all meet regularly, would choose an experiment we wanted to perform, and would study that experiment. And you werent limited to just one. (92)
- I was Penny Pom-Pom. I really enjoyed the club: learning new science 'tricks', the social interaction with my peers, and playing with/teaching the kids we visited as our characters. (45)

Leadership Opportunities. Another evidence of behavioral engagement is leadership opportunities, an important tenet of effective ECA (Dewey, 1916). Persistence also shows moderate, significant correlation to leadership in the club ($r = 0.493$, $\rho = 0.000$), indicating that those who were members longer (greater behavioral persistence) were somewhat more likely to occupy leadership positions. There is only one outlier data point, an active member who played Suzy Science the first year the club started at her school (no membership prior to leadership). There is a moderate, significant correlation between behavioral engagement and leadership ($r = 0.586$, $\rho = 0.000$), meaning that members with higher behavioral engagement scores were somewhat more likely to be those members in leadership positions. There is only one outlier, a squad leader who seldom mentioned his leadership role, focusing instead on the interactions with his peers:

> My most memorable experiences with Suzy Science were in experience awkward situations with friends and then working together to make it through. (I say “awkward” because talking to a bunch of 4th graders about a strange topic while you are dressed up as a clown is nothing if not awkward.) It was a challenge to get up there and be serious, especially when you were watching your friends perform, when all you

> really wanted to do was giggle at the whole situation. We were all pretty serious about our grades and school, so rarely did we have time where we could be "responsible" and still have so much fun. That's probably one of the most memorable things about Suzy Science to me. (22)

There was one squad leader for every 4-6 members, which meant that 20% of the membership (1 leader per each 5-member squad) during any year occupied leadership roles. Squad leaders were generally chosen in the spring of the preceding school year. Females and males assumed leadership roles as squad leaders in a ratio of 2:1, or in the same ratio as the club composition. As shown in Table 4, survey respondents also indicated leadership roles of females to males in the same proportion, 2:1. Also on Table 4, one-year members were seldom squad leaders (3%) (exceptions occurred during the first year the club started at each school); 58% of two-year members held leadership roles and 86% of 3-year members were leaders. There were almost twice as many leaders in the public high school (due to larger size and more squads) than at the smaller private school. The ratios of Caucasians to non-Caucasians in the club was 5:1, while the leadership by race was 5:4, meaning that proportionally, more non-Caucasians held leadership roles compared to the club composition.

In SSWK, squad leaders were designated for networking and information purposes. Effective leaders appear to have been more democratic than authoritarian. Eleven respondents (12%) stated that they appreciated the leadership opportunities they had while others revealed that Whiz Kids took turns being the leader or that no one was the leader within their squads during their school visits. In a sense, all the Whiz Kids were leaders for the young elementary school children as they gave their demonstrations. They commented on being leaders:

- It was fun, something different, and I liked taking on a leadership role. (36)
- My squad worked really well together. We experimented with different leaders with different ideas. I think that that helped us be a good group so that we could provide each other feedback on each other. (81)
- We worked well together, and nobody seemed to be bossy or felt the need to be the leader and criticize. (92)

The role of Suzy Science shows a moderate, significant correlation ($r = 0.492$, $\rho = 0.000$) with overall behavioral engagement, meaning that those who served as Suzy Science were somewhat more likely to have higher overall behavioral engagement scores. However, the opportunities were limited because there was only one Suzy Science each year. There is only one outlier in the data. It does not refute this finding based on the initial premise that Suzy Science would be a female member. With the second highest behavioral engagement score, one member (22) became a squad leader, but he did not assume the role of Suzy Science during his participation in the club.

Survey respondents were active leaders in the club, with 46 (47%) having served as squad leader at some point during their membership and 10 (11%) having served as Suzy Science. The importance of leadership roles was evident in the relationships between leaders and squad members as shown in these comments:

- We worked well together I think the main squad leader really set the tone. we had a good one. (83)
- I see one of my squad leaders at least once a year and to this day she still calls me Cosmic Connie, my character name. (3)
- [Squad leaders] Help them pick a 'trick', pick a costume, get their 'schtick' together. Practice in front of the others. (45)

The overall leadership position was decided early in the club formation. When I was developing the idea for the club, I discussed some possible formats the club might have with students in my classes to get their input and to generate some possible names for the club. One suggested that the club be called the Chemistry Clowns. It was clever and I like alliterations, but I did not want everyone dressed up the same, all as clowns, and I did not want young children to associate 'clowning around' when dealing with chemicals. One girl off to the side who had not been a part of our conversations suddenly offered, "It's a dumb idea! Nobody is going to join that club. Girls don't like science." To prove her wrong, we named the club after her, Suzy! Suzy Science. One of the other kids asked what the rest of them would be called.   We brainstormed all kinds of alliterations; Billy Basketball, Sammy Soccer, Betty Butterfly, Betsy Bunny, etc. many that came to be regular characters in the club and the collective group became the Whiz Kids. But I never could convince that particular girl, Suzy to join the club. Years later, Suzy, now an adult came to see me after school one day. She was now the science teacher for all the grade levels at her elementary school and came to ask me if the club named after her could come to her school and teach science to her students.

Female respondents described their SSWK leadership roles in this manner:

- The leadership role that I felt was part of Suzy Science was nice since I did not stand out in other areas of school leadership. (32)
- I was many different characters and did many different experiments. My favorite was the bunny, but I cannot remember its name. Toward the end, I was a squad leader. (25)
- [As squad leader,] I would expect that [new] student to learn how experiments worked and how to explain it younger children. This student should be confident in his/her presentation. I would also expect this student to see and practice his/her presentation. (81)
- It allowed me to utilize creativity, leadership skills, communication skills and definately a sense of humor. (30)

These comments show the perception that female respondents liked and enjoyed science activities and physical science topics, and that they assumed leadership positions easily. They were definitely not deficient, low self-esteem girls (Handel, 1986).

Persistence of Effort. Behavioral engagement also evidenced by persistence of effort, particularly, investing time as well as effort. For SSWK members, time typically spent in all the club's activities averaged about 3 hours per week, although respondent answers varied from 0.5 hours to 20 hours. Practices took place before and after school during the first two months of school (we had to be ready for American Education Week presentations at {the local} Mall by the first week in November) while school presentations occurred throughout the year and took the entire school day (leaving the high school right after morning attendance and arriving back at the high school just in time to catch the buses home, a school regulation for our club). Evening and weekend events took approximately 4-5 hours, depending on the type of performance and the distance traveled from the high school.

Former Whiz Kids reported the amount of time they spent in the club. One respondent did not answer, 36 (39%) cannot recall or are not sure of the total time, and 56 (61%) indicated that they spent at least four hours per week in club activities. More specifically, 17 (18%) indicated that they spent over four hours per week in club activities, between 4-20 hours.

As shown in Table 4, one-year members were just as likely as three-year members to spend time each week in the club activities beyond expectations. Males reported spending nearly twice as much time as females and 33% more private school members than public school members reported spending extra time in the club activities each week. Non-Caucasian members reported spending more additional hours than Caucasian members. Their responses included the following comments:

- If memory serves, the club met one to two times per month for one hour at a time (2 hrs per month). We completed approximately one school performance a month which took the majority of the school day (5 hours per month). On a select basis, we completed various offsite perfomances at local shopping malls (2 hours). I'd spend maybe another hour or so memorizing my presentation and/or practicing my experiment. I would extimate that I spent 8 to 10 hours per month working on club activities. (80)

- I don't recall how much time we spent preparing. I think when we went to the schools we spent most of the day there. (11)
- I remember a couple hours per week + periodic field trips to local schools. (41)
- 3-5 hours avg, except when demo days and then it would 8-10. (49)

However, analysis shows no correlation between time spent in club activities and behavioral engagement, meaning that respondents indicating greater amounts of time spent in SSWK activities were not necessarily those with the higher overall behavioral engagement scores. This result appears contradictory, but may be more understandable with the passage of time and confusion with the survey question. On the survey, 36 respondents (39%) admitted to having difficulty in recalling and guessed or drawing blanks on the amount of time invested in SSWK. Sometimes respondents indicated the time involved for a single performance that took the whole school day.

Some confusion may have occurred regarding the question's intent. The question asked, "Approximately how much time did you spend per week on club activities at the highest point of your involvement?" However, since the club did not meet weekly, perhaps the question would have been better stated, more specifically requesting the amount of time spent at the practices held at the beginning of each school year. The pilot study had not revealed any confusion on this question, but perhaps this was due to the nature of the other clubs being used as an alternative. Other possibilities might be that "flow" (Csikzentmihalyi, 1988) makes this question meaningless to them, it is the time elapsed since their involvement, but probably the wording of the question itself posed the biggest problem.

Regardless of the response requested, some respondents (14%) still gave the total weekly time spent for participation in all their ECA:

- 9-10 hours, including marching band. (25)
- Probable 2 to 3 hours with the ones that I had the most interest in. (29)
- Between all of the clubs I was involved with- about 4-8 hours per week. (30)
- Everyday I was doing something I was in many clubs. (31)
- 5 hours a week, at the height of the involvement. I also was in band and technical support for the drama club. (45)
- I was involved in several extracurricular activities in high school and 4 out of 5 days I had some activity. (87)

Despite any confusion, these responses still tend to indicate that SSWK membership did not demand exclusive participation or limit members from exploring interests in other ECA. Members reported that typically the time invested in SSWK was much less than in other ECA:

- I know that I enjoyed it, however, the time commitment didn't compare to sports and other activities so [SSWK] was not my biggest priority. (6)
- I did not spend much time as a Whiz Kid compared to some of the other activities I did in HS. (26)
- 2 hours Suzy Science 10 hours for all clubs (pep club, yearbook, volleyball, etc.) (13)
- I was highly involved in SS&WK activities. . . .but compared to other activities (namely band and orchestra) it was an "easy" activity to fulfill. . . .It was not a huge demand on our time compared to hours invested in practice and performances for marching band, varsity band, etc. (61)

Some respondents reported that they spent more time in sports than in SSWK and/or that sports interfered with their participation in SSWK. Most of these comments were made by female respondents:

- I was always involved in sports afterschool and then Suzy Science. (32, female)

- My parents were not really interested in what I participated in besides sports. (92, female)
- Unfortuantely, atheltic commitments sometimes created time conflicts, so I was not able to participate in the club's meetings and performances as much as I would have liked. (7, female)
- Running cross country and track took so much time it left little for other activities (56, male)

Behavioral persistence, as measured by the longevity of ECA participation, (Darling, Caldwell & Smith, 2005; Posner & Vandell, 1999) increases benefits derived from ECA. Of the 352 participants, 80% of them remained members of SSWK for the maximum number of years possible, based on the grade level at which they first joined the club. That is to say, those students who joined as sophomores could be members for up to three years, those students who joined as juniors could be members for up to two years, while seniors could only be members for one year. There is a moderate, significant correlation between the number of years that individuals were members in the club and their behavioral engagement ($r = 0.589$, $\rho = 0.000$), meaning that those who were members longer were somewhat more likely to have higher overall behavioral engagement scores. There are no outliers to this finding.

As shown in Table 4, 36% of the respondents belonged for one year, 57% belonged for two years and 7.6% belonged for three years. Females and public school respondents averaged slightly more years in the club than males and private school respondents. Race was not a factor in longevity. The respondents' long-term investment of time and commitment to the club (see Table 4) are evident in these responses:

- I was involved all four years of high school. I became involved because of my older sister who was 'Suzy Science'. (32)
- I participated in Suzy Science one year, my senior year, when asked by Ms.Kralina. I didn't even realize it existed until she asked me or I would have joined years before. I was Candy the clown. (92)

- I believe I was involved for 2 years and attended all events. I was Betsy Bunny. (11)
- Ferdinand the matador Suzy science treasurer, soph-senior Very involved. (49)

There is also a strong, significant correlation ($r = 0.635$, $\rho = 0.000$) for behavioral persistence and attendance and involvement in the club activities, meaning that those who were members longer were very likely to be those members who attended and participated more regularly, perhaps indicating a higher level of participation to one of dedication to the club. This pattern is tested against the three outliers that represent three active one-year members. One joined as a second semester senior, one joined as a junior the year prior to my transferring schools (thus, limiting her persistence), and the third one left after one year, having assumed leadership roles in ECA sports: “I wanted to participate in a broad range of activities in high school, both athletically and academically.” (1) Thus, the data still tend to support the finding.

Another very strong, significant correlation ($r = -0.948$, $\rho = 0.000$) related to longevity, or behavioral persistence shows that the grade at which students joined the club is inversely and highly correlated to observing the leadership or assistance of other members. That is, younger new members (sophomores), more than older new members (seniors), observed and acknowledged (and probably received) help and guidance about the club’s activities from more experienced members. This is indicative of reaching higher level of potential development when collaborating with more capable peers or through problem-solving under a teacher’s guidance (Vygotsky, 1978). The one outlier still tends to support this finding in that this gifted freshman (90) in chemistry joined the club with her older sister who mentored her as well.

This concept of learning with more capable peers is evident in these remarks:

- We meet as a group to learn our character roles and demonstrations. (7)
- We recieved specific training in the experiment we were proposing. It was usually done by another student who had done that activity in the past. (64)
- An experienced Suzy Science and the Whiz Kids would help the new person by explaining what goes on and what is a good experiment. (85)
- If I remember correctly the other students in the club helped to prepare and train new members along with club sponsors. (15)

Routines and Procedures. The fourth measure of behavioral engagement is following the rules and knowing the routines and procedures of the club. Former members recalled considerable details about the club's procedures in these comments:

- [The steps are] 1. pick an experiment to do 2. learn about the concept that the experiment is supposed to illustrate 3. practice doing the experiment itself 4. learning a presentation that is kid friendly and still illustrates the concepts of the experiment. (90)
- Some of my memorable experience included having fun with my peers, going on fieldtrips teaching students how electricity worked, watching the person doing the lemonade stand change the lemonade's color by pouring it from one pitcher to another, and participating in International Day. (81)
- I can't remember, but I assume that we had a monthly meeting with everyone and were assigned characters and picked experiments. I assume we practiced with our group on our own. Periodically we would go to elementary schools and the Science Center to teach little kids. (36)
- I know we prepared our supplies, practiced, developed a presentation order, and met after the event to write thank you notes [letters written in response to the elementary children's fan mail to the Whiz Kids]. (21)

One former member summarized the activities and routines very succinctly:

> If memory serves, the club met one to two times per month for one hour at a time (2 hrs per month). We completed approximately one school performance a month which took the majority of the school day (5 hours per month). On a select basis, we completed various offsite perfomances at local shopping malls (2 hours). I'd spend maybe another hour or so memorizing my presentation and/or practicing my experiment. I would

> extimate that I spent 8 to 10 hours per month working on club activities. (80)

Despite the passage of time, many former Whiz Kids remembered considerable routines and procedures of SSWK. An analysis of their responses shows a strong, significant correlation ($r = 0.698$, $\rho = 0.000$) between behavioral engagement and knowledge of routines and procedures. This means that those former members who were more behaviorally engaged in the club were highly likely to discuss or mention club routines and procedures more often than those who were less behaviorally engaged. This pattern was true even considering the one outlier who was one of the first members (5) and the most persistent female to portray Suzy Science. Her high level of engagement offers strong support for this finding, in that she knew all the routines and procedures, helping those in her squad as well as the other squad leaders, sending them notes to remind them of meetings and performances (verified by copies in club files).

Teacher Interactions. Behavioral engagement is also evidenced in teacher interactions. Despite the lack of any questions on the survey regarding interactions with the teacher/ sponsor, 75% of the respondents indicated that the teacher was influential in their participation in the club with 59% commenting on individual interactions or personal relationships with the teacher. The coding schema (see Appendix F) was used to identify teacher interactions. There is a moderate, significant correlation ($r = 0.434$, $\rho = 0.000$) between attendance and involvement with teacher interaction. This means that former members reporting greater attendance and involvement were somewhat more likely to interact more with the teacher. Simply stated, this finding shows that a person has to be there in order to interact with the others who are there, including the teacher.

There is one outlier to this finding. However, on closer scrutiny, the student (20) had indicated on the survey that he had only been a member for one year, when in fact he was a member for two years. Considering that he was one of the original members and it has been over two decades since he graduated, the variation is understandable. His high teacher score using his two-year attendance and involvement then fits the pattern.

Corollary to that same premise is the moderate, significant correlation ($r = -0.403$, $\rho = 0.000$) of the grade level entering the club and the students' interactions with the teacher. The negative sign indicates that younger new members reported more interactions with the teacher (me) than did older new members. This is indicative that those who joined the club at a younger grade level (sophomore), could belong to the club for more years, and therefore would have an extended period of time in which to interact with the teacher as well as others, due to longevity. It may also indicate that younger new members more so than older new members still identified more with the teacher in a multi-grade setting. There are no outliers to refute this finding.

Examining this correlation further, 45 (49%) respondents made references to me specifically by name and 24 (26%) made references to me in general (the teacher) as being influential in or encouraging their participation. As shown in Table 4, nearly twice as many females as males reported that they joined the club because they liked the sponsor, but over twice as many males as females reported being invited by the sponsor to join the club. More Caucasians reported that they joined the club because they liked the sponsor, but more non-Caucasians than Caucasians reported being invited by the sponsor to join the club. Twice as many public school respondents as private school respondents reported that they joined the club because they liked the sponsor, but nearly the same percentage of students at each school reported being invited by the sponsor to join the club. Nearly twice as many 3-year members as 1-year members reported that they joined the club because they liked the sponsor. None of the 3-year members, but 18% of the one-year members reported being invited by the sponsor to join the club.

Respondents with the highest percentage of responses that the reason they joined the club and what they liked best about the club was because they liked the sponsor were those members who were members for the longest time. This finding reiterates the previous findings regarding the significance of a qualified and dedicated sponsor (Holloway, 2002; Jussim & Eccles, 1992; McLaughlin & Irby, 1994; Rehberg & Schaefer, 1973; Reis, Colbert, & Hebert, 2005; Reis & Diaz, 1999; Silliker & Quirk, 1997; Van Matre, Valentine, & Cooper, 2000). Because the members who had the highest percentage showing teacher bonding were not necessarily the oldest members, this finding tends to question the findings by Crosnoe, Johnson, and Elder (2004) that school attachment and extracurricular participation decrease with age while student-teacher bonding increases with age.

Of all the responses, 59 (63%) comments describe interactions with the teacher on an individual basis (i.e., my teacher talked to me) while 34 (37%) comments describe the teacher interacting with the group as a whole (i.e., our teacher told us). Members described their interactions with me as the club sponsor this way:

- Ms. Kralina showed me that I could swing the glass of water around without it falling. (14)
- I remember and still have the notes from students and you. You would send us the school fundraiser telegrams and I still have those. (21)
- Ms. Kralina and I felt that "chemical explosion" might not be an appropriate title for children given the climate of the times. (20)
- I think Mrs. Kralina just recruited me [to be a member]. (18)
- Mrs. Kralina was a great teacher and friend as well. (8)

- I remember Mrs. Kralina helping me with the science demonstration. (9)
- I believe we worked with our science teacher who suggested different experiments we could do. The teacher helped teach us about the experiment so we were knowledgeable and could then educate the people we were performing for. (86)
- The encouragement of a teacher to join the group. (79)

One Whiz Kid gave more detail about her interactions with me as club sponsor:

> I recall Mrs. Kralina talking to me on an individual basis, showing examples of experiments that other students were doing, asking about my interests, and providing resources and suggestions to help me find an experiment I could do with enthusiasm. We then listed and gathered the equipment needed. I had several opportunities during club time to plan the content of my presentation and customize my set-up. I also had time and guidance to practice the whole procedure until it was efficient and memorized with a good comfort level. (26)

Behavioral Engagement in SSWK: Benefits

Psychological Development. Having accrued considerable evidences of behavioral engagement, former SSWK members might be expected to exhibit the characteristic benefits of behavioral engagement. One of the major benefits of behavioral engagement in ECA, psychological development and competencies in a positive peer context for ECA participants is cited in many studies (Fredricks & Eccles, 2006; Harrison & Narayan, 2003; Silliker & Quirk, 1997). While three respondents did not comment, the rest of the former Whiz Kids reflected now as adults on their own perceived growth and development that took place during their participation many years ago with these responses:

- The club was something to look forward to during the week. A place where general questions could be asked and answered, potentials expanded. You did not feel stupid there, there you could get help! (76)
- I love being with people, learning new things and making others happy. The club did all of this for me. . . .20 years later I am thrilled to be thinking about it again. (5)

- I was involved in Suzy Science earlier in my high school career so it helped boost my confidence and my training as a leader in our high school. (3)
- For me, being the leader was important and I was proud to play that role. (36)
- I think my participation helped contribute to my growth & development and increased my confidence during a rough period in a child's life. (67)
- [SSWK] increased my ability to work in a group, speak to an audience, engage those that may be disruptive or not participating, explore something that I wouldn't normally take on and enjoy it. (82)

Another member explained his evolving perceptions this way:

> My science teacher sold me on the idea. ;-) If I'm being honest, initially the thought of getting out of school for a few hours was pretty enticing. However, the concept of bringing science to life for elementary students and the signficance of potentially sparking a life-long curiousity in science for some of them were the most important reasons I decided to become a member. (62)

One respondent described the evolving nature of his polished presentations:

> We worked together well. we had to or we would have had problems with timing, demostrations not be continuous, being able to see when to start the next demo. All of these required communication to be effective. In the begining it was difficult, because everyone was learning how work with each other, the experiments, and leading the demo. It got a lot easier, after practice ahead of time and after the first day at a school with live participants. (49)

Some students came to the realization that they liked learning new things, even complicated concepts. Respondents offered these hindsights:

- You are always learning new things. (31)
- It increased my knowledge in that science, when put in the proper context, can be learned in the same way as any other social science. I also liked the education that I recieved while participating in the club. It made me realize that anything is learnable even theories and concepts that are complicated. (54)

But some members said differently, insisting they had not learn anything new:

- Not really, most of what we were teaching, I had already learned in my classes. (67)

- Not really because it was basic. (73)

While some studies (Broh, 2002; Simpkins, Ripke, Huston & Eccles, 2005) contend that sports participation builds self-esteem, ambition, character development and social ties, other studies contend that students in non-sports ECA experience the most positive adjustment, improved grades and attitudes toward school and highest academic aspirations (Darling, Caldwell & Smith, 2005). Former SSWK members reported feeling that they were doing important things, things that matched their own interests, and while having fun, they were doing adult-level work, with 18 of them (20%) stating that the club activities were rewarding or worthwhile; 25 (28%) saying they enjoyed working in a science-related activity, 34 (38%) reporting that they had fun doing the activities; and 45 (51%) enjoyed teaching elementary school children. Respondents made these remarks:

- Although we got the chance miss classes, we had to be responsible enough to make up all of our work. This helped us learn how to manage our time more wisely. (81)
- I was looking to enjoy people and to feel like I had something to offer. I felt pretty good about both areas. (26)
- It was a fun way to give back to the community. (74)
- I felt like I got to know a lot of people with similar interests to me that I might not have otherwise had the chance to get to know. It helped a portion of my high school feel more like a community. (19)
- Interacting with people who enjoyed science and showing kids it could be fun. (53)
- I think it was about as rewarding a club as there was at the high school. (48)

Participating in SSWK made one member feel she was trusted to act like an adult:

> When I look back, I feel that it made us more responsible, more accountable, and gave us the feeling that we were trusted enough to leave school and go teach elementary school students. We were trusted to use fire and other elements around elementary school students! (92)

One respondent felt the work in SSWK was meaningful and important:

> I wanted to expand upon the education I received in the classroom and

> share that knowledge with others. I wanted to help others understand that learning can be fun and silly. It's not always boring and about taking notes, doing homework and studying for tests. (37)

Another respondent explained what was involved and what had mattered to him:

> It was a great way of teaching kids about science with fun people in a fun environment. It wasn't a boring presentation where kids had to sit in folding chairs and dangle their feet towards the floor. It was something they could participate in and think was interesting. Also, the other team members were usually pretty fun people (I'd argue that it takes some pretty extraverted personalities to dress up in funny costume and stand in front of an audience, no matter what the age of the audience). There were a lot of laughs and smiles among the team members during the presentations, and even if you had a bad group of students, the team members were all still having a fun time being around their good friends all dressed up in silly costumes. Also, because children were the main audience, there wasn't as much stress as there would be in a 'serious' presentation. If a team member stumbled a little or missed their line or forgot some information, rarely would the kids notice and another team member could slide in and help them through and it would all appear seamless to the students. (22)

The repeated successes that athletes enjoy increases their self-confidence and maturity and transfers into academic pursuits (Broh, 2002), but all students need to experience repeated successes, not only in ECA, but in classrooms, so they can reap these same rewards. According to respondents, activities in SSWK provided some of the same repeated successes for its members:

- There are some basic concepts that I remember to this day from a few of the experiments I heard over and over. (26)
- I venture a guess that I gained some confidence in my knowledge and that the glass of water would not go flying across the room. (14)
- I believe my confidence and presentation skills grew considerably in that time. (48)
- Having to teach something makes it stick in your head better than just reading about it. (12)
- You can't help but listen to the presentations from the other members, and over time from listening to the same things drills it into your head, but not in a bad way at all. (68)

- The club was a way for the high school students to use that knowledge they learned by teaching it to younger students. By teaching it they are better able to understand and will retain the knowledge longer. (38)
- At first I wasn't really comfortable around that age of kids so it was a little awkward at first and not that imaginative. After building some confidence and having gone thru the spiel so many times, I had a lot of lines I used that would get the kids laughing or more interested. (77)
- The demonstrations improved with time and practice as the members began to work more and more closely. (4)

The elementary school children in SSWK audiences needed and wanted repetitions, according to one former member: “Many kids requested that the experiments to be repeated.” (88) One respondent explained the value of repetition this way:

> I remember realizing how important it was to not have any dead time. At first this was very nerve-wracking, trying to keep the children's attention. But it became easier and more natural as I gained familiarity and confidence with my content. . . I remember feeling incredibly nervous and unsure of myself before (and during!) my first presentation. Even though I had practiced and knew "the material", I was scared that I would mis-communicate some of the information and that the audience would then take that and communicate it out to their friends, etc. However, by the end, I had developed a level of comfort and confidence. The presentation became like second-nature and took on a sense of fluidity. (26)

Life Skills. The second benefit of behavioral engagement is the life skills, attitudes, values and social networks developed and refined in ECA that follow youth into adulthood (Barber, Eccles & Stone, 2001; McLaughlin & Irby, 1994). Survey respondents made several different references to the life skills, values, social networks they developed as a result of their participation in SSWK. Former Whiz Kids described some benefits of their participation in these terms:

- It allowed me to meet others and have more friends as I went through high school. (81)
- I wish that I had experienced the encouragement of the Whiz Kids as a child! (40)
- The friendly people and how they helped you with your science experiment. They made it fun. (42)

- Those kids were excited to have us come, and you could see that we were getting them interested in science. We added value to the grade school science experience. (64)
- As a great learning experience for myself. Taught me more about communication. I initially did not want to participate, but a friend made me, and so I became a "French Maid" for a while. (12)
- It did get us out of class for the day but at the time we were held accountable for the material that we missed. We would have to let teachers know ahead of time that we would be gone and there were no excuses for not getting the work done. It helped some of us with better managing our time in my opinion. (29)
- I wish this type of club were present in our schools today as science is being pushed back with the emphasis on reading & math achievement/ test scores. I think NCLB may be leaving science behind. (60)

Respondents spoke of the skills learned in SSWK that carried over into adulthood:

- Like most good things in life, it's the retrospection where you see what good you were actually doing and what an impact you could make. (46)
- Putting on the demonstrations for children was my first regular experience with public speaking which helped develop skills that I still use today in jury trials. (20)
- People learn best when they teach others. The science concepts got reinforced for us as well. Also, learning to present in front of others is definitely needed in today's society. It was wonderful preparation for that. (10)
- I was able to teach children about things in a fun and friendly environment while learning how to present things in a professional manner. These skills have carried with me today. (74)
- At the time, the costumes seemed ridiculous. Looking back and now that I have kids of my own, I can see what a difference they made. At my daughters old elementary school, I tried to re-vamp a parent volunteer program to do the same thing that Suzy Science was all about. The trouble I had was with the teachers and scheduling time to get the parents in the classroom. They seem to be all about the state/government testing and couldn't/wouldn't work us in even though they liked the ideas we came up with. (11)

For one former member, some of the attitudes he developed in the club are becoming strong convictions for him as an adult:

> From what I can remember, Suzy Science and the Whiz Kids was way ahead of its time. I don't remember ever learning science in elementary school in such a fun and engaging environment. I have four-year-old

> twins now, and I hope there is a program like this for them when they get to elementary school. Hopefully, they would also have the chance to participate in such a club in high school some day. I also fear the recent trend toward teaching to the test may not recognize the intrinsic value of a club like Suzy Science and the Whiz Kids both for the elementary kids and for the high school students. My boss tells me the best way to learn a subject is to present on it. Most of us, if we have to make a presentation on a topic, will do whatever it takes to learn everything we can about it. Suzy Science provided this opportunity for us in high school. (62)

Decrease in Problem Behaviors. The third benefit of behavioral engagement in ECA is a decrease in problem behaviors (Caldwell & Darling, 1999; Darling, Caldwell & Smith, 2005; Feldman & Matjasko, 2005; Hoffman, 2006; Mahoney, 2000; McNeely, Nonnemaker & Blum, 2002; Shann, 2001). The extent of observable problem behaviors in SSWK included some tardies to practices, missed practices, or late permission notes or lunch money. There were no late arrivals on the day of the presentations because the school buses arrived and departed punctually.

This study did not investigate any anti-social behavior of the Whiz Kids, but respondents frequently discussed the opposite behavior, that is, well-adjusted social interactions depicting how they all worked well together in the club and in their squads. When asked to rate how well their squads work together on a scale of 1 - 5 where 1 is no cooperation at all and 5 means good communication and cooperation, 73 (79%) said their squads got along well with a 4.4 average rating while 14 (15%) respondents said they did not remember, and 5 (5%) said they were not sure and could not give evidence either way. As shown by the data in Table 4, variables of school, gender, race and longevity indicated little or no differences in perceived squad cooperation.

Former members who made more mention of working well together were somewhat more likely to have experienced greater cooperation within their squads. On the survey, respondents made 99 references to working well together:

- I thought everyone worked well together. (38)
- From what i recall we got along well and collaborated well. (54)
- From what I remember I think we worked well together, I don't remember any instances where we didn't. (63)
- Great cooperation. everyone was there to help. (13)
- I don't recall there being any issues, everyone helped each other with everything. (18)

But some reported it just as the absence of conflict:

- I don't remember any complications in the group, but it was 20 years ago. (8)
- Wow, this was like 22 years ago, but I don't recall any problems with the squad. (20)
- I'm sure we worked together well. But, really, I don't remember. (51)
- I can't ever remember their being a problem. (58)
- I honestly dont' really remember specific instances but from what i remember there were no major squabbles or areas of disorganization. (90)

Computer analysis shows a strong, significant correlation between working well together and building a sense of being part of a team and community ($r = 0.623$, $\rho = 0.000$), meaning that respondents who discussed working well together were highly likely to be those members who perceived a sense of community within the club. Testing this trend against the two outliers in the data reveal two members who offered even stronger evidence of the tremendous sense of community spirit they perceived:

- There were very few disagreements among our group and no one really believed that they "knew" more than others, which makes it easier to come to consensus. (22)
- We got along great and we would share ideas and change around who was demonstrating what at different times. We were really supportive of each other. (29)

Club members through the years did work well together and collectively that added new dimensions to the club. Some years, the members designed club sweatshirts with their character names on the back. Some years Whiz Kids sold Eggs-perigrams (chocolate Easter eggs attached to greeting card with egg experiments to do at home described on the back) to raise money for Special Olympics and to buy club sweatshirts.

Problem behaviors for some may also include TV watching in that it breeds passive behavior, according to researchers (Posner & Vandell, 1999; Shann, 2001). Whiz Kids' responses suggest that there may be a corollary to the study by Anderson, Huston, and Schmitt (2001), that SSWK (ECA) participation promotes watching more educational TV which reflects members' increasing interest in science, thereby increasing their participation in more academic and service volunteer opportunities with leadership options. The former Whiz Kids made several unsolicited remarks regarding TV watching, but only in the present tense, as adults, not as youngsters or adolescents:

- I love doing science experiments and seeing science shows on tv. (85)
- Let's face it, until the Science Channel came on the air, there were no role models on TV for science/math junkies. It's all about athletes and popularity. (61)

One respondent credits SSWK for his current increased interest in science-related TV programs:

> I am fascinated by watching science-related issues on TV or reading such articles, and I think Suzy Science was able to tap into that part of science for me: I didn't have to be an expert, know everything, or even do it for the rest of my life. However, I was able to see things from a 40,000-foot level and understand the make-takeaways, and in this way, I believe Suzy Science helped me enjoy science more. (25)

Behavioral Engagement in SSWK: A Summary

Behavioral engagement in SSWK is characterized as an enthusiastic group of students who regularly attended and actively participated in nearly every performance event with 80% faithfully belonging to SSWK throughout their high school careers. Even 10-25 years after their participation in the club and with no direct question regarding characters or demonstrations, over 50% of the survey respondents still remembered their character and recalled 56 specific science experiments (see Appendix G). All 92 respondents (100%) made references to various routines and procedures utilized as SSWK members. Those respondents with higher behavioral engagement scores were:

1. highly likely to exhibit a higher overall ECA engagement score;
2. highly likely to discuss or mention more club routines and procedures;
3. highly likely to indicate greater effort and involvement in training;
4. somewhat more likely to report greater attendance and involvement;
5. somewhat more likely to have been members for a greater number of years;
6. somewhat more likely to have served as a squad leader, or as "Suzy Science;"
7. somewhat more likely to rate themselves higher on organization and efficiency;
8. likely to have described their most memorable moments on the survey; and
9. likely to not be members of a particular gender.

Members invested time in and out of school to practice and perform science demonstrations for elementary school children. Time commitments were not so severe as to prevent members from participating in other ECA. Members who invested more time through their greater attendance and involvement in SSWK were:

1. more likely to be those who joined SSWK at lower grade levels (sophomores);
2. somewhat more likely to view club activities as rewarding, worthwhile experiences;
3. somewhat more likely to be members for a greater number of years; and
4. somewhat more likely to report more interactions with the teacher.

Younger new club members appreciated learning from their more experienced peers and by interacting with their sponsor. Gender was not an issue in this science club in that girls were active participants, demonstrated various physical science concepts and held leadership positions within the club. Survey respondents indicate that they perceived that they worked very well together, enjoyed sharing their interests with other students, and gained valuable insights about themselves and concepts outside the standard curricula during their days out of school. Those who were members for a longer time, i.e., showing greater persistence, were:

1. highly likely to have observed the leadership of other members;
2. more likely to report interactions with the teacher;
3. somewhat more likely to have occupied leadership positions;
4. somewhat more likely to observe how members helped each other; and
5. not necessarily those members with higher measures of scientific attitudes.

As in other ECA, behavioral engagement in SSWK fostered the psychological development of its members, while refining skills, attitudes and values important in adulthood, particularly, getting along with others and working cooperatively. Former members, now as adults, report watching more science on TV. Former Whiz Kids have taken science learning beyond the four walls of the classroom and into the future with them through the presentation skills, confidence and self-esteem that they developed as members of SSWK.

Behavioral Engagement in SSWK: Regression Analysis

Using the coding schema (see Appendix F) as discussed earlier, survey responses were coded and then tallied to give each survey respondent a frequency composite score for each variable within behavioral engagement. Adding together all the variable scores algebraically for these variables generated an overall behavioral engagement (BE) score for each participant. The final tally of all the behavioral engagement variables is shown in Table 5. The 897 responses coded as behavioral engagement (BE) constituted 34 % of all survey engagement responses.

In analyzing the responses from the former Whiz Kids, overall behavioral engagement shows a strong correlation ($r = 0.721$, $\rho = 0.000$) with overall ECA engagement. This means that those members with higher overall behavioral engagement scores were very likely to be those members with higher overall ECA engagement scores. Even the one outlier of this correlation still seems to confirm this finding. This highly

Table 5. Summary of All Behavioral Engagement Responses

Coding	BEA	BEL	BEO	BEP	BER	BET	BEW
Variables	Attendance	Leadership	Others	Persistence	Routines	Teacher	Working
Total # of Responses	118	79	14	181	380	26	99
Percent of Responses	13	9	2	20	42	3	11

engaged individual had the second highest emotional engagement score, nearly four times greater than her behavioral engagement score. As was her nature, she described her SSWK experiences simply from a more emotional perspective: “It was an enjoyable time spent with other students who enjoyed science and who enjoyed sharing science with younger children.” (7)

Using a multiple regression analysis for overall ECA engagement and behavioral engagement as measured by attendance and involvement (BEA), leadership (BEL), leadership by others (BEO), persistence (BEP), knowledge of routines (BER), teacher interactions (BET), and working well together (BEW) yields $F_{(7, 91)} = 13.232$, $\rho = 0.000$, reiterating a strong correlation ($r = 0.724$). After correcting for interaction effects ($r^2_{adj} = 0.524$), analysis shows that 48.5% of the variance in overall ECA engagement can be explained by these seven behavioral engagement variables. Thus, this data tends to support the assertion that behavioral engagement is an important component of ECA engagement (Fredricks, Blumenfeld & Paris, 2004).

Cognitive Engagement (CE) in SSWK: Introduction

Cognitive engagement is evidenced in the students' thoughtful and intentional decisions or reasons to participate, investment and intent to learn and master skills and challenges set before them, persistent contributions in meaningful endeavors, and pursuit of life goals. An overall cognitive engagement score has been assigned to each participant based on the sum of the individual cognitive engagement measures.

Former Whiz Kids made deliberate choices and offered thoughtful reasons for joining SSWK. They were willing to learn new skills and concepts presented in the training they received in preparation for their demonstrations. Their cognitive engagement was also evidenced in their persistence beyond expectations to improve their individual and squad performances, consistent efforts in endeavors perceived as worthwhile and reinforcing life goals and values. The benefit of cognitive engagement, academic achievement was assessed for SSWK members by their perceived mastery of skills, increase in science knowledge and decrease in science misconceptions, scientific attitudes, perceptions about elementary children learning from them, and perceived need for more inquiry in schools.

Cognitive Engagement in SSWK: Evidences

Reasons for Joining. The first evidence of cognitive engagement is intentional choice to participate and respondent comments on the survey are in various states of alignment with research findings. Responses contradict some studies (Olszewski-Kubilius & Seon-Young, 2004) that boys choose to participate more in science, science-related, and academic clubs while girls are more involved in drama, theater, art and dance. Perhaps with its costuming aspect, SSWK bridges the gap between science and theater ECA. SSWK longevity records tend to support contentions (Olszewski-Kubilius & Seon-Young, 2004) that there is greater sustained involvement in talent-related clubs, competitions and volunteer work than in sports. Membership rosters show that SSWK attracted more females than males, contradicting some studies (Darling, Caldwell & Smith, 2005; Simpkins, Ripke, Huston & Eccles, 2005) while supporting other studies (McNeal, 1998; Posner & Vandell, 1999). Rosters also contradicted studies (McNeal, 1998) in that there was a higher percentage of students participating in SSWK at the private upper socio-economic high school (~6%) where after-school sports participation was required than at the larger middle/lower socio-economic public high school (~1%). Race percentages for SSWK were lower than school percentages at both institutions. Several former members reported being active in many ECA (McNeal, 1998).

Female respondents reported their intentional choice to join SSWK this way:

- I was always a studious kid and by being in Chem Club (and by being Suzy I was president), other kids got to know me in a different way. Yeah, I was smart, but I could have fun too even if I didn't play sports or dance or cheerlead. (8)
- I was very involved in other clubs as well but never felt overwhelmed. (5)
- I was involved in other clubs, sports, and activities in HS and this [SSWK] was a memorable experience for me as noted before; however, I don't know if it stood out more than playing varsity tennis or singing in choir. (55)
- I think Suzy science is a great club... looking back, I wish that I had had more involvement. Our school placed a much greater emphasis on sports and the arts (plays, concerts, etc)... not on Science clubs! They should change their focus! (6)

Male SSWK respondents reported their choice to be involved in SSWK this way:

- Even though I was quite gifted as a student, I would not have necessary sought out an activity to be involved in because I was already quite busy with a number of other sports and activities. (49)

- Suzy Science was negligible because of theater, but as far as theater probably 20 hours or more a week. (71)
- On general high school club activities, I would usually spend around 10-15 hours/week. On Suzy Science, I would say that my involvement was only applied when we had an event coming up. (78)

One former member described his decision to join SSWK this way:

> I was more involved in student government, the music program, and sports. Those dominated my high school experience, so I don't think that the Whiz Kids had a major impact on my high school experience. I certainly remember enjoying it, but I don't think it was particularly impactful on my experience. (78)

Participation in SSWK was frequently impacted by participation in sports ECA, particularly for seniors. Former members made these comments about sports and SSWK:

- I have always done sports related activities and never part of a science or smart kid group. (86, senior male)
- As I said previously other than sports, I wasn't in a bunch of clubs/groups. So this was really something that connected with me or I wouldn't have stayed in it. (82, senior female)

Interest in the subject matter, science, (Eylon, Hofstein, Maoz & Rishpon, 1985) was given as one of the main motives for joining SSWK:

- I enjoyed science and working with kids so I thought it would be fun to teach them about the subject. (4, female)
- I enjoyed my chemistry class and my teacher was in charge of it. I also remember that my girlfriend at the time was a Suzy Science member and I am sure that did not hurt influencing me. I would have joined either way though. (86, male)
- I probably joined because my best friend did or because I enjoyed the chemistry class and teacher. Maybe a little of both. (82, female)
- An interest in science and an intriguing club. (40, female)
- I have always enjoyed science and math. (87, female)
- I wanted to be a member of Suzy Science and the Whiz Kids because I enjoyed science and liked being able to teach others. (81, female)

However, the reasons that respondents gave for joining SSWK offered some very different perspectives than the literature reviewed regarding science ECA (see Table 6). The SSWK survey collected very favorable responses (96%) for definitely meeting

Table 6. Reasons for Joining SSWK and Percent Responding

Reasons Given for Joining SSWK Club	Percent Responding
Sounded like Fun	34
Liked Science	33
Liked Teaching, Working with Children	31
Resume, Grade, Career, Learning	26
Friends, Sibling Belonged	26
Liked Sponsor	24
Social/Belonging	18
Invited by Sponsor	16
Giving back, rewarding experience	12
Wanted to be involved in ECA	7
Costumes, Performing	7
Got out of School	6
To help my Self-Confidence	3
Wanted to join ever since club performed at my grade school	1

student needs and expectations. Yet not a single respondent (0%) specified 'meeting my needs' as a reason for joining the club; nor did former members cite reasons, such as seeking a challenge beyond their classroom studies (0%), preparing for a career (0%), or learning time management skills (0%) to help them in their classes, contrary to some findings (Olszewski-Kubilius & Seon-Young, 2004; Shannon, 2006). Three respondents (3%) did not answer this question on the survey and some participants gave multiple responses. Although many respondents expressed an interest in teaching and working with children, their interest was not expressed as exploring a definite career option. Although it may have served as a good apprenticeship opportunity for potential teachers, no one cited joining the club to further preparation to become a teacher, nor was the club ever promoted as a future teachers club.

Former members now adults offered individually as many as seven reasons as to why they joined the club, with the average being 2.3 reasons. Motives for joining the SSWK club (see Table 6) focused primarily on interests in science or teaching children. The number one major reason cited by former members for joining SSWK is that the club "sounded like fun". In fact, the word *fun* is specifically mentioned 130 times in reference to the club for the 92 surveys completed. No one (0%) joined SSWK to improve their public speaking skills. More importantly, none of the respondents (0%) indicated that they joined this science ECA because of teacher coercion, course requirements, or because their parents made them, completely contradictory to other findings (Abernathy & Vineyard, 2001; Baker & Leary, 2003; Eylon, et al, 1985). While all the quotes are not listed here because of space limitations, the following is a sample of the responses given for why former Whiz Kids joined SSWK:

- It [SSWK] sounded like fun thing to do. (43)
- It seemed like fun and very rewarding.(44)
- The fun, friendship and learning new things. (51)
- It was nice to be in a club that had nothing to do with athletics. It was just fun and educational for the kids--not a contest. (79)
- I liked the teacher and thought she would make it fun. (63)
- It sounded like a fun way to serve the community. (67)
- I thought it would be fun to teach young students in costume. thought it was a clever approach; to get us to dress up in fun costumes and keep their attention with fun experiments. (89)
- I enjoyed science and had heard it was a lot of fun too. (77)
- The fun way that we were able to present science to young kids. (90)
- Intially the idea of going to the elementry schools but then it was just a really fun thing to be involved in. (28)
- Sounded like fun, got out of school, got to eat lunch out and once I was a member I really enjoyed doing the activities of the club. (86)
- I also remember my friends being involved and that it was a fun activity. (36)
- The fun environment and enthousiasm that Mrs. Kralina showed. (64)

One former member elaborated on his reason based on hindsight:

> I think that the reason that you kept the kids that you did and the group that went through with me, and there were some of them who were there for all four years of their high school career if I remember correctly, won't be there if it weren't fun. It was fun, it was social, I think people enjoyed it. But it's only as an adult that you can reflect what you really got out of that, but I don't think most kids can do that in their high school years. I was there because it was fun, at the time. That's the bottom line. As a adult, I can look back now and see the value of what it taught me. *[How did you know it was fun?]*
>
> You sold it very well. Other people that were in the group sold it very well. "Come do this because it's neat because we go here and we go to grade schools and we go out to {the local mall} and we dress in funny costumes and we get out of class and it's just a lot of fun." That's how high schoolers promote things. (I-6)

A female member offered this perspective:

> Well, the most attractive to the biggest number of students would be they'd get to get out of school. And every high school student would love to get out of school. Yeah, it's really fun! Secondly, it's fun! That is what high school students are really looking for, as well. It was really fun! I had a great time. I'd do it again. I'd do it every year! If you had it here, I'd be in it. If they had you, you are a reason they should do it. You are a reason because you are a fabulous teacher. You were our sponsor and if

> the sponsor of the club is absolutely amazing, kids are drawn to the club because they want to be around that person.
> *[If it did not change your attitude toward science or achievement or help in a science class, why would anyone want to be in a science club?]*
> Because those things don't matter to high school students, at least, not to a lot of them. They don't think, like, "Is this going to help me with science in the future?" "Is this going to help my career path?" That's not what they are looking for! They want to belong to a group, and Suzy Science gives you that. That's one reason why I mentioned that I liked it. Because I felt a part of the group but I also felt special. By you giving me a unique character, and by you and your personality, and the way that you lead, you made me feel special and everyone in our group felt special because of that. High school students want to feel special.
> You could get lost in a club, especially at {my school}. It was huge! In a lot of clubs, you are just one of a mass, a mass of people. No, you don't feel special. You might kind of feel part of a group, but not like it was a special group (laughs). So why would they want to be a member of Suzy Science? Well, because they get the opportunity to do something fun, what I thought was fun, which is to teach students something about science. And it wasn't something boring! It was something very cool! It wasn't the typical earthquake, animal science presentations like I remember when I was growing up, but something really exciting. (I-7)

One member offered a very unique reason for joining SSWK: "I'd wanted to be a member since grade school. I always liked it when they came to my school when I was little, and so I grew up wanting to be a part of it." (68) As a youngster, he had seen the club perform science demonstrations at his grade school. His goal when he reached high school was to become a member of the club himself. He was a very determined youngster. One summer while visiting in a city over a hundred miles from my school, I was walking down a street with some friends when suddenly I heard a child yelling excitedly in the distance and pointing in my direction, "That's her, mom. That's Suzy Science! Over there!" I did a double take. He must have been referring to me, but I had never been in any classrooms or ever introduced to any elementary school classes as being the sponsor. Sure, the elementary school teachers knew me because I led their faculty meetings prior to our trip to their school. His teacher must have pointed me out to him at some time while I was in the hallway, cleaning glassware between presentations. Of course, he had confused me with the main character but he associated the club with me. Now at a time and place far removed from his school and that particular situation, this young child had recognized me from across the street and wanted his mother to meet me. I looked forward to having him as a member when he arrived at the high school several years later.

Other respondents cited these motives:

- [I joined because of] Our teacher, Mrs. Kralina. I wanted to be in any club that she had going on! Even if she wasn't leading this group though I would have wanted to be in it. I liked the idea of teaching others interesting things about science. (3)
- I think some of my friends from school/church recruited me into it. (11)
- My friend didn't want to belong to the club "alone". Also I'm pretty sure there was some logic that I could use it for my college applications. I'm sorry to report that it was not a genuine interest in science, although I did find Ms. Kralina's classes and lessons fascinating. (14)

Many of the comments by respondents told of the impact of school conditions, home influences and career aspirations that guided their decisions to participate in SSWK (Tamir, 1990-1991). Their comments included these:

- Mrs. Kralina asked me to be a member and I liked the other kids involved. Also it gave me the opportunity to do something else besides band and art away from structured school hours. I liked that. (70)
- Not really sure, but I do remember wanting to demonstrate things to younger kids. I also liked being able to skip classes occasionally to go out on a Suzy Science trip. (24)
- My older sister talked me into it and I am glad she did. (32)
- My brother did it and had a good experience. (68)
- Everyone always looked like they were having such fun. I didn't particulary think Science was fun until I was able to view it through this exciting theory of learning. (30)

- I became a member of Suzy Science and the Whiz Kids to work with elementary children and make learning fun. (66)

From the literature, reasons to join ECA include resume building. The private high school promotes its educational program to their clients by stating that every single graduate goes to college. The school has a special counselor designated to assist every student with applications and to practice application essay writing with them during the summer after their junior year. The public school did not offer this same service and none of the public school students indicated joining the club to build their resume. However, twice as many public high school respondents reported actually putting it on their college applications than did the private school respondents. Three female respondents (3%) from the private high school indicated that they joined the club for resume building (Guest & Schneider, 2003; Swanson, 2002):

- Great way to socialize with friends and resume builder (Our school always had us thinking about college). (36)
- [The reason I joined was for] Costume, resume potential for college admission. (57)
- I was able to do exactly what I set out to accomplish. Participate in an educational extra-curricular activity and use it on college resume's. (46)

In direct opposition to those comments, a male from the same school refutes resume-building as a valid reason for joining the club:

> Well, you asked...I would say, "Why on earth would a high school student dress up in a funny costume to go teach elementary school kids about science when they could stay behind and hang out with their friends, stare longingly at the cute blonde in the front row of econ class -- you know, the one who smells sooo good and, ohmygod, did I tell you she said hi to me the other day -- and be absorbed by all of the things that high schoolers are absorbed by? I mean honestly..." Or, I guess I could say, "Because that's not the reason they wanted to be in the club: they were doing it to put on the college resume." I don't believe the last point (although I strongly believe the first point), but I don't think that many of the Whiz Kids just wanted to get out of classes...y'know? (78)

Reasons for joining SSWK were mentioned at various times throughout the survey rather than just in response to the direct question about joining. Although showing only weak correlations, the reasons given for joining SSWK still impacted the former Whiz Kids' responses regarding attendance, leadership by others, routines, interactions with the teacher/sponsor, life goals, working with children, their interests and ties to the school, actions taken in new positions, new positions encountered with costumes, future self-images, and the basis for their most memorable moments.

Training Sessions. The Whiz Kids' intentional intent to learn was also evident in the training sessions as members learned the routines of the club and prepared their presentations. The initial training involved the entire club meeting to discuss working with children, stage presence, and classroom control (see Appendix H). The first meeting usually included a sample presentation by last year's members who would be this year's squad leaders to show the new members exactly what the club did. All the members pretended to be an audience of elementary school children and while the presenters were still out in the hallway getting organized and ready to enter, the audience chose two students to be 'vegetables', or non-participants and two to be 'trouble-makers'. When the presenters arrived, it would be their challenge during their presentations to identify these designated 'children' and take corrective action to engage them and to reduce the disruptions. Afterwards they had to identify for the audience who were the 'vegetables' and who were the 'trouble makers'. The new squad leaders correctly picked them out of the crowd every year and amazed all the new members with their skill in handling 'children' while giving presentations.

Based on their expressed interests, Whiz Kids were then placed in squads of 4-6 members with each squad focused on a major physical science topic. Then each squad met separately with the sponsor to choose demonstrations and collect necessary equipment. Individual squads met 2-3 times to practice their order of rotation, the demonstrations, and ‘door-rushing,’ a phenomenon where all six squad members try to get through the classroom door simultaneously while carrying their materials. This last feat required the most practice, but would effectively catch the audience’s attention so their presentations could begin.

While skill mastery should fall under the cognitive engagement component, the training component was only weakly correlated to cognitive engagement scores ($r = 0.329$, $\rho = 0.001$) and to skill mastery ($r = 0.312$, $\rho = 0.002$). However, based on survey responses, the training component of SSWK shows a strong, significant correlation to former Whiz Kids’ overall behavioral engagement score ($r = 0.671$, $\rho = 0.000$), meaning that former members making more comments regarding the training they had received were highly likely to be those members with higher overall behavioral engagement scores. Even the outliers support this finding with gusto. It is no surprise here that one of the original “Suzy Science” would be an outlier, for her enthusiasm and input into the club were inspiring and she initiated some routines as well: “I was very involved in the program all four years of high school and assisted in recruiting several of my friends. . . .Our groups tradition was to make a pyramid at the entrance to every presentation. I was usually on the top because I was so little.” (5) The other outlier was a diligent squad leader who also took her responsibilities seriously: “I was ontime and very responsible in my duties when I participated in science club. I was considerate of others and was always willing to learn how to teach others and to learn from them as well.” (81)

The training component shows a strong, significant correlation to overall ECA engagement score ($r = 0.602$, $\rho = 0.000$). Former members who indicated greater effort and involvement in training were highly likely to be those who were not only behaviorally engaged in the club but also overall more actively engaged in the club. There are no outliers to refute this finding. The training component also shows a moderate, significant correlation to behavioral engagement in knowing the club routines ($r = 0.483$, $\rho = 0.001$), meaning that the more references made to the training they had received, the greater number of references the former members made to the club's routines and procedures. This may be interpreted that the more training they received, the more likely that the members knew and better understood the club routines and could include them in their responses to survey questions, even years later. There are no outliers in the data to refute this finding.

As shown in Table 7, more members from both schools indicated they received training in their groups with only a small number reporting one-on-one training from the sponsor, or me. More females reported training in the group while more males reported training done on their own. More Caucasians reported training in the group while more non-Caucasians reported training done on their own. One-year members reported training done on their own while two-year and three-year members more frequently reported training done in the group.

Former members were asked to describe the training they received in preparation for their demonstrations. On the survey, 62 (67%) remembered that they had received training, 28 (30%) could not remember the training component, and two respondents (2%) did not make any response. Of those that remembered the training, 13 (21%)

described the sponsor doing the training, 24 (29%) described doing the training on their own, and 25 (40%) described helping each other learn the demonstrations and techniques. Whiz Kids recalled their training sessions happening like this:

- My recollection is that you were given a character along with a costume. Training involved understanding the scientific concept that you would be sharing with children and then some training with how to speak with younger children and communicate with them effectively. (2)
- The training was pretty deep in that we had to be ready for anything to happen during the presentations. We needed to be able to cover multiple experiments or topics in case someone was unable to attend. (29)
- The new student would need to learn an experiment as well as "rules of the road" to teach children. (13)
- You first assigned a character name that suited that person's talents. Then you would find a simple science experiment or two. I think training was fairly easy. I did the plastic straw instrument experiment was was a natural for me since I play oboe. (61)
- If I remember correctly the other students in the club helped to prepare and train new members along with club sponsors. (15)
- Learn a demo Learn how to present Learn how to explain Learn how to respond Learn how to write student back fan mail. (69)
- Students would be given a briefing on how to deal with elementary aged children, and what to expect when they are doing the experiments for them at an event. They would be given an experiment, and asked to know how to explain it. (59)
- Watching the older members of the group and learning your experiment. You would need to prepare what you would say at the schools and just be really excited about science. (28)
- I don't remember lengthy trainings, but i know we weren't left out there to flail either. I think I got a handout on centripetal force and my costume and Ms. Kralina showed me that I could swing the glass of water around without it falling. (14)

Others were vague about training:

- Couldn't say, really. I simply did as asked of me. (52)
- There were practice sessions. (74)
- Training and preparation did not take long. (88)
- Can't remember everything, but had to work well with younger children. (58)
- Training sessions after school and coaching. It was thorough. (71)

One former member gave this perspective on training:

> Much of the training and preparation was around how to handle our particular area of expertise, i.e. the demo we were showing off to the kids. This was handled by Ms. Kralina and I remember her as being particularly good about this training. The other thing that we were coached on was how to actually interact with the younger kids we'd be teaching -- this was more difficult because, well, I was a high school boy and was probably more fond of harassing little kids than teaching them science. (78)

Many respondents, particularly females, emphasized how visual learning modalities were effectively addressed through the club presentations and improved their learning (Day, Langbort & Skolnick, 1982; Huppert, Lomask & Lazarowitz, 2002; Quaiser-Pohl & Lehmann, 2002). Six (7%) references were made, five by females:

- The club reenforced fundamental concepts learned in classes by giving them applications. A way in which to visualize the scientific phenomenon. (49, male)
- I'm a visual person, more so back then, it gave a 'face' to science instead of abstract classroom concepts. (70, female)
- I very much enjoyed my involvement in the science club, it was an opportunity to actually see science come to life. (76)
- Absolutely! At that point in my life everything increased my knowledge since I've always been a visual learner. I was able to see the demonstration and watch the cause/effect of the younger students. . . . I would have thrived in more coursework if other disciplines had clubs similar to Suzy Science. It allowed me, a very visual learner, to see how science worked in a simple step-by-step manner. (16, female)
- I really don't think it would have had the same impact because young children need to see visuals and have hands - on activities. (66, female)
- It opened my eyes to cause and effect on a greater scale then just with me as an individual. I struggled with the book work vs. the visual demonstrations. I loved what we did and how it moved people I always wished I could have understood the "why" more. (5, female)

Clear expectations were established at the onset of training (see Appendix H) so students understood how the club functioned and supported its members in the activities. Results of this study seem to align closely to the findings for ECA in urban settings

(McLaughlin & Irby, 1994), even though this club took place in the suburbs of a large Midwestern city. Former SSWK members indicated that they appreciated the overall organization of the club. The club had guidelines that stressed commitment, integrity, and responsibility to the group, as well as to oneself; clear and firm expectations; opportunities to be worthy of trust and to earn respect; chance to learn the needed skills, attitudes, and values; a group and a purpose that meant something to them; and caring and well-meaning leaders. Whiz Kids responded in similar manner:

- My teacher encouraged us all to be involved. (6)
- We were expected to behave and do a good job for the elementry schools and I would say for the most part that is the kind of kids that group consisted of. (28)
- This club was extremely well organized and we were well trained. . . .We always knew what our roles were, the expectations for each class presentation and our objectives.” (62)
- [I wanted to join] When I first saw some of the experiments. (42)
- I was ontime and very responsible in my duties when I participated in science club. I was considerate of others and was always willing to learn how to teach others and to learn from them as well. (81)
- I wanted to have fun and I did, I wanted to get out of school sometimes and do something with what I knew and we did that, and it helped me better at working with other people in group settings. (29)
- Charismatic leader. (13)
- First of all, I didn't really have expectations to speak of. Come'on I was a teenager. Second, what's better than hanging out with your friends, making new friends, and having fun. (80)
- I think we were kids who really had a strong respect for each other's differences. It made us become more trusting which was a benefit then and is something that is used everday thereafter. (30)

Two respondents described their responsible behavior this way:

- I've mention the expectation that everyone would take things seriously and do these demonstration well for younger students. I'm not saying that the members of the group were always on their "A" game, but they knew why they were there and that was emphasized over and over again by Linda. Also, you couldn't do this without doing a little "homework" and knowing how to do your demonstration. (2)
- I believe that my attendance was consistent and regular throughout. If memory serves, I believe there was only one occasion during my few

> years of participation where there may have been a schedule conflict, and this caused me to miss the first hour of the morning session. The other 4 or 5 members of the team were able to cover during that time and my absence didn't harm the overall team's performance. (22)

Cognitive Challenges. Their intentional commitment, or cognitive engagement, already shown in their reasons for joining SSWK and training for presentations is also evidenced in their persistence toward goals and working on activities that have challenge and meaning for them. Former Whiz Kids spoke of the challenges they received as members of the club and their efforts to achieve these goals. Facing challenges shows moderate, significant correlation with former members' cognitive engagement scores ($r = 0.524$, $\rho = 0.000$), or stated another way, those who saw the challenge in the activities were somewhat more likely to be more cognitively engaged in the club. Examining the one outlier in the data still tends to support this finding. The outlier is the member who stressed the challenges he enjoyed during the presentations: "When the experiments did not work and you had to work on the fly to make them work." (49)

Facing challenges also shows moderate, significant correlation with overall ECA engagement scores ($r = 0.464$, $\rho = 0.000$), meaning that those who discussed the challenges present in the performances were somewhat more likely to be more actively engaged in the club overall. Based on the memories of these former members, this correlation tends to indicate that Whiz Kids who liked the challenges in the club were somewhat more likely to be those members who were more cognitively as well as more actively engaged members of the club. Still in support of this finding, the two outliers demonstrate the different types of challenges these members perceived within the club activities. Both outliers were members for two years and both served as squad leaders.

The first outlier represents a gifted member who flourished on content challenges (Eylon, Hofstein, Maoz & Rishpon, 1985). This member said:

> The suzy science and science olympiad clubs provided a scientific outlet that encouraged education growth. HS typically provide extra sports teams as a supplament to education. The science club actually allowed people to practice science and not berated for wanting to learn more. The clubs along with Mrs. Kralina's classes encouraged active problem solving and applied problems that allowed creativity in the class room. (49)

The second outlier represents a member who more frequently addressed the challenging educational aspect of developing meaningful presentations for the elementary children:

> The time commitment for a new student joining the club I believe would vary whether they were joining an established team or if they were starting a new team. If they were joining an established team, they could expect 2-3 hours of training, and then a little "on-the-job training" during some of the performances (as the other team members wouldn't remember every possible situation that the team member may face). If the student was starting a new team, the time commitment would be much greater. They would have to find others to join their team, develop an idea, collect resources for their presentation, step through practice sessions on how the presentation would flow, figure out how to transport their equipment, decide roles and responsibilities, etc. As a result, I would imagine that the investment could be closer to 15-25 hours (which I think was the case for our team of 5 people). (22)

There were 67 references (13% of all cognitive engagement remarks) regarding the challenges of the club. They described meeting these challenges this way:

- I was encouraged by my teacher to join. At first I didn't want to but when I checked it out I really liked it. Being a memember of the club challanged me and I am very happy that I was encouraged to join the club. (54)
- I remember most of us having specific plans for adjusting to the age group. For my presentation, there were some scientific concepts that I simplified or did not mention with the younger kids. (26)
- We laughed a lot. We had a good time and enjoyed each other's company. It was also funny when an experiment would go haywire,

we would have to ad-lib a little bit while we tried to figure out how to make it work. (24)

- My experiment was the marshmellow man in the the vacuum. I loved watching the kids reactions when the marshmellow man would get really big and then shrink when the vacuum was off. It was great to be able to show them the experiment and then relate it to real life situations. (28)
- Suzy Science and the Whiz Kids is an example of experiential and practical learning. (14)
- I tried to make science exciting and fun. (85)
- The visits were important in sharing scientific concepts with younger students through a more fun and interactive delivery than a typical lesson. (55)
- [What I liked best about the club was] the challenge. (47)

One member described the challenges she encountered this way:

> I remember the squads I was involved in always had a great time. We knew each others experiments and could help out if something went wrong or change gears if for some reason an experiment malfunctioned. The club meetings helped us plan our persona's characteristics and practice our experiments as well as what order to perform them. This helped the days to go smoothly. If after the first classroom there were some glitches we could quickly work them out before the next classroom. (23)

Persistence. Persistence in cognitive engagement has been defined as continued effort beyond expectations. Beyond just learning their demonstrations, several Whiz Kids continued refining their presentations and revising their explanations so the elementary children would better understand them. There is a strong, significant correlation ($r = 0.635$, $\rho = 0.000$) between measures of overall cognitive engagement and cognitive persistence, meaning that the students more cognitively engaged in the club were highly likely to persist longer in working on their presentations beyond expectations than students less cognitively engaged. There are no outliers in the data to refute this finding. The members' persistence is also evident in their overall ECA engagement, as seen in a moderate, significant correlation ($r = 0.511$, $\rho = 0.000$), where members who spent more time and effort beyond expectations were also somewhat more likely to be overall more actively engaged in the club. There are no outliers in the data to refute this finding.

Table 7. CE Variables, Survey Response Percentages Disaggregated by School, Gender, Race, and Longevity where School: A = Public; B = Private; Gender: F = Female; M = Male; Race: C = Caucasian; NC = Non-Caucasian; and Longevity: N = Years in SSWK

Variable	School		Gender		Race		Longevity		
Values	A	B	F	M	C	NC	1 Yr.	2 Yr.	3 Yr.
Trained by Sponsor	15	13	16	10	14	13	9	17	14
Trained by Self	29	17	26	23	26	19	18	27	43
Trained in Group	31	20	33	16	30	13	15	31	57
Improved Demo	58	43	57	45	53	5	45	54	86
Squad Changes	38	30	36	36	37	31	21	44	43
Memorable Learning Experiences	10	17	11	13	14	0	18	10	0
Valued Best Learning Experiences	10	10	11	7	12	0	9	12	0
Science Knowledge Increased	82	77	80	81	79	88	76	81	100
Scientific Attitude Composite	4.0	4.2	4.1	4.0	4.0	4.3	4.0	4.1	4.1
Success w/ Children	4.3	4.0	4.4	3.9	4.3	3.9	4.3	4.2	4.5
Evidence of Learning	66	60	69	55	61	81	45	71	100

Cognitive persistence also shows a moderate, significant correlation in making changes to improve their demonstrations ($r = 0.559$, $\rho = 0.000$), which means that those who persisted beyond expectations were somewhat more likely to practice, perfect and improve their demonstrations. As shown in Table 7, public school members, female members, and members with more years in the club were more likely to work and improve their demonstrations than private school members, male members, and one-year members. Non-Caucasians were somewhat more likely to improve their demos than Caucasians. Three-year members were nearly twice as likely as one-year members to change, refine or improve their demonstrations. Based on club records and their comments, many of these three-year members changed squads, thus physical science topics as well as completely different demonstrations.

There is one outlier data point to this correlation and after examining the outlier, it appears that other factors are impacting this finding. The one outlier data point actually represents eight former members with persistence (efforts beyond expectations) scores of zero who have self-rated the maximum score for changes in their performances. All eight respondents who were outliers gave no responses that indicated they had spent any time and effort beyond the club expectations in their presentations. Instead, all eight members cited that their performances showed the maximum change because they had become more comfortable and confident in their presentations. This might imply their perceptions that presentations are better when the speakers are more confident or when the speakers are more confident, the presentations are better. It might also imply that these members believe that spending time and effort to master or better understand the content would not improve their presentation as much as constantly repeating their demonstrations. Saying the same thing over and over gave them more confidence in knowing that they were saying the same thing correctly, although this does not necessarily imply that they had explained the concept as accurately as possible or that they had any better grasp of the concept.

These eight outliers reveal several interesting facts for comparison:

- Only one of the eight (13%) indicated any original shyness upon entering the club (respondents' total for shyness is 13, or 14%)
- Only two of the eight outlier members (25%) indicated that they had no interest or did not like science (respondents' total for negative or no interest in science is 27, or 29%)
- The eight indicated a strong change in their attitude toward science, 4.5 on a 1-5 scale with 1 = no change and 5 = greatest change (respondents' average is 4.5).
- The eight indicated a strong change in their knowledge of science, 3.9 on a 1-5 scale with 1 = no change and 5 = the greatest change (respondents' average is 3.9)

Further examination of these eight outlier members reveals several interesting facts in contrast. While the eight outliers indicated no efforts beyond expectations and the only change in their presentations was their own increased confidence and comfort levels, the remaining respondents offered these comments about the specific changes they had made in their presentations:

- We would refine out presentation and pick up on what went well and what need more work. (6)
- People would start to learn how to read the kids and figure out how to talk to different ones. (71)
- Towards the end, I really knew how to 'work the crowd'. (45)
- I remember realizing how important it was to not have any dead time. (26)
- Each time I talked in front of the kids, I was more at ease and learned how to handle the ones that didn't really want to pay attention. (8)
- The differences could be based on how the students were responding and the grade level that it was being shown to. (29)
- Eventually I got into character more and tried to make science more fun. I remember demonstrating my presentation like a little story. (35)

This contradictory finding may indicate the students' perceptions separating effort versus ability and their perception of effort versus mastery. Further investigation of this complexity is needed.

Persistence also shows a moderate, significant correlation with making changes to improve squad presentations ($r = 0.561$, $\rho = 0.000$). This means that those members who showed high persistence (made efforts beyond expectations) were somewhat more likely to be those members who worked at improving their demonstrations and improving their squad presentations. There is one outlier in the data distribution. This outlier is a former member who stated that changes were made and why they were made in the squad's presentations, but used a passive voice as if she did not play a part in these changes: "I don't remember specifics, but know things were changed to keep the younger children's attention" (58) Thus, the data still tend to support this finding.

The impact of their persistence also corroborates the moderate, significant correlations between those who made changes in their demonstrations and those with higher overall cognitive engagement ($r = 0.596$, $\rho = 0.000$) and between those who made demonstrations changes and those with higher overall ECA engagement scores ($r = 0.542$, $\rho = 0.000$). These correlations indicate that those members who made changes in their presentations were somewhat more likely to be more cognitively engaged in the club and overall more actively engaged in the club. There are no outliers in the data to refute the first correlation. The one outlier in the second correlation represents a former member (30) who left the question blank, so it is left to the readers to draw their own conclusions from the silence. However, conjecture based on the high engagement of this former Suzy Science with a higher than average overall ECA engagement score and the leadership position that she held would tend to support this finding.

Based on their responses, 49 (53%) of the Whiz Kids saw and/or made improvements to their demonstrations, 15 (16%) saw or made minor improvements, and none of the respondents (0%) indicated that they saw no improvements in their presentations. Of the remaining respondents, 25 (27%) cannot recall if they ever saw or made any improvements in their demonstrations and 3 (3%) did not respond to this question. Respondents described their efforts in this manner:

- The first time was hard. I had to get use to talking in front of poeple but by the end I had no trouble. (31)
- Added more detail as I became more comfortable. (88)
- I recall having fun brainstorming with {my friend} about what jokes or humorous anecdotes to work into the demonstration. Afterwards, she would tell me what worked and what didn't. (20)
- I definitely grew more confident in my communication skills and became a better presenter, as far as speaking clearly and with enthusiasm and learning how to involve the students in a meaningful way. When I started, I was much more nervous and hesitant with my presentation. (19)

In fact, former Whiz Kids had a lot to say about their personal persistence, or continued effort beyond expectations of the club:

- I know for a fact that once I was able to get some audience feedback I was able to tweek my performace to what the audience liked, disliked and kept their attention. From first show to last, I think my delivery was much more smooth and relivant. I was able to communicate exactly what my expirement entailed, why it worked and what made it so in a much more sccinct and interesting way. (46)
- I was much more comfortable after the first few times. Getting up in front of people, even children was not one of my strong suits. One difference I can remember was putting the gyroscope on my nose at the beginning, then putting it on one of the children's noses, and then finally putting it on the teacher's nose. I think the kids got the biggest kick out of seeing the teacher do it. (68)
- As I spent more time in the club I participated in more difficult experiments. I believe I started with showing the power of batteries by lighting steel wool with 2 "D" batteries. I progressed to a Bernoulli experiment, center of gravity demonstrations, and finally the "lemonade" experiment. As I was able to not only comprehend the principles behind the experiments as well as explain them appropriately, I was given more difficult experiments to perform. (23)

Whiz Kids were persistent in their efforts not only to improve their personal demonstrations, but to improve their squad's overall presentations. The efforts to improve their squad's overall performance show moderate, significant correlations with their cognitive engagement scores ($r = 0.427$, $\rho = 0.000$) and with their overall engagement scores ($r = 0.437$, $\rho = 0.000$). The correlations tend to indicate based on the memories of these respondents that members who worked together to improve their squad's overall presentations were somewhat more likely to be those members who were more cognitively engaged and who were the more actively engaged members of the club. There are two outliers for both correlations and they represent members who left the question regarding changes in squad presentations blank, so it is left to the readers to draw their own conclusions from the silence. The lowest outlier in each correlation was the same member (39). Closer examination shows an error in her report of club membership for three years instead of two years as shown in the club records. This discrepancy may be the source of the deviation from the trend suggested by respondents.

On the survey, 11 (12%) recalled specifically how they adjusted their squad's presentations to meet the ages, needs and abilities of the classes they visited. Twenty-two (24%) of the members also remembered making changes in the order or numbers, for variety, to keep their interests up while 3 (3%) acknowledged that they never made any changes to their squad's presentations, adjustments or changes in sequence. Four (4%) did not respond and 52 (57%) admitted that they could not remember any specifics about their squad's presentations. As shown in Table 7, public school members, Caucasian members, and members with two or more years in the club were more likely to improve their squad presentations than private school members, non-Caucasian members, and one-year members. Gender was not a factor in squad improvements, meaning that the same percentage of females and males reported making squad changes.

Former Whiz Kids recalled several ways in which they tried to improve their presentations in the following comments:

- Our roles with in the squad changed so that it was fair and we got to take on other roles. I became good friends with everyone else in my squad too which was nice to know more people in school...especially as a freshman. (32)
- I recall being more confident in our presentation and less reliant on the whole group [SSWK] as we proceeded from class to class. (41)
- We tried to adapt the presentations so that a sixth grader would get more scientific explanation, while a 1st grader would be show more of the application side. (49)
- I don't recall a lot of specifics only that we knew certain experiments didn't always hold the attention. We had figured out what some of the equipment could do beyond what we started with and would incorporate that into the presentation. (82)
- Depending of grade level we may add more demonstrations or cut some out. like the younger kid we would make theirs more hands on and fewer demonstration , and the older kids would get more information and a little less hands on. and more demonstrations. (83)
- We might change the order of who talked first based on the grade level that we were visiting. We had the cubic bubbles, the vacuum pump marshmallow men, and the paper airplanes. We definitely learned to do the airplanes last as they got the kids excited and then they wouldn't listen to the others. (8)
- There were times that we would change up who was doing which presentation so that we wouldn't be doing the same thing all day long. We also tried to pick some where two of us would work together to do the presentation. (29)

One member explained the changes in her squad's presentations in this fashion, showing considerable mastery of concepts and perceptions:

> From what I recall, we would change things up depending on the type of classroom that we were visiting. For example, if we were visiting an classroom of the "smart" kids in the Galactic program, we were a little more serious and more on the specific scientific side. If were were visiting a classroom where the students were having a general science class, we would bring in more silliness and fun, especially if it was after lunch. It took more energy to capture the attention of kids just returning

> from lunch and recess. (54)

Some changes were due to the events of the time:

> The presentations changed to adapt to the varying age groups. Some 'jokes' that worked well with 6th graders were not going to work with 1st graders. Obviously, we also changed our language from technical to simple based on the age group. Specifically, I remember changing the name of my demonstration from "The Chemical Explosion" to something else because of the Space Shuttle explosion that occurred while I was in the club. Ms. Kralina and I felt that "chemical explosion" might not be an appropriate title for children given the climate of the times. (20)

Another respondent described his group's persistence in considerable detail this way:

> The greatest differences between our first and last presentations were our familiarity with the information and the overall flow of the presentation. Our group's task was to explain the Scientific Method, which we demonstrated through the use of a popcorn popper that was placed on the top of a bullseye target with concentric circles emanating from the center (where we placed the popcorn popper). The idea seemed easy enough at first, but we quickly realized that younger children couldn't immediately square the connection between popping popcorn and working on science (depending on the time of the day, we found that sometimes their stomachs cared more about our presentation "and the final result" than learning about our topic). Overcoming this task became a challenge for our team. As we went on, we changed the order of our presentation (when we introduce the concept of a Hypothesis, when we talk about Independent/Dependent Variables, etc.) to better fit the learning styles of children. We found that a gradual advancement of knowledge worked better than throwing a "summary" of the Scientific Method at them at the beginning of the presentation and expecting them to remember it throughout the presentation. Therefore, our modified version didn't let the students know when we were "finished" and kept them interested as they always wondered where/what we were going to go/do next and how it was related to what we had already discussed in the presentation. We also changed which team member was in charge of different topics, to better fit interests and the type of personality needed at various points in the presentation. For example, I started out talking about the Independent Variable, but eventually transitioned into the opening were we spoke about a "Hypothesis", what it was, discussing other examples in life, and how it applied to the task at hand. Also, our "control" of the audience (where children sit, when to ask them questions, how to deal with "troublesome" students who were more interesting in mocking us than learning something) definitely improved as time went on. Sitting among the students when another member of the team was presenting went a

> long way in quieting the troublemakers. We also modified our equipment slightly to make the presentation go more smoothly (stopped using oil in the popper because it made a mess presentation after presentation, brought in a second target bullseye map since the first would get dirty after an hour or so, etc.) (22)

Valuable Learning Experiences. SSWK members made a deliberate choice to persist toward meaningful goals, rather than being satisfied with their current level of individual and collective performances (Eccles, Barber, Stone & Hunt, 2003; Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002). Survey responses show a moderate, significant correlation between persistence and valuable learning experiences ($r = 0.421$, $\rho = 0.000$), which means that students persisted in their efforts longer when they perceived the club activities as important learning experiences. There is one outlier to this finding, which represents a member who gave ample comments such as this one that still supports this finding:

> Experiencing science, rather than just learning about it. There is a huge difference between reading science in a text and actually performing the reaction or illustrating a principle. I know I appreciated the excitement of watching things happen and learning how to make them happen in practice, rather than just theory. (49)

There is also a moderate, significant correlation between persistence toward goals and challenging situations ($r = 0.428$, $\rho = 0.000$), meaning that former members who felt that they persisted longer or harder were somewhat more likely to be those members who perceived more challenge in the club activities. The pattern is tested against the two outlier cases. The first outlier is a member who demonstrated high persistence, yet seldom voiced any perceived challenge to the club activities. She joined as a senior because she enjoyed learning new things and: "I wanted to do what my friends wanted to do. . . .I was initially afraid of science. . . .Listening to others talk about it, especially people my own age, made me realize that I could learn it, and it was actually much more interesting than I initially thought." (45) The second outlier is a member who spoke more often of the challenges as curiosities that he loved to investigate: "I have always had a passing curiosity with science and structure in particular. . . .I always had the look of wonderment in my eyes when I was younger concerning science. This club fulfilled that curiosity." (41) The unperceived, unmentioned effort needed to investigate those things in which he was interested or curious tend to allude to the concept of 'flow' (Csikzentmihalyi, 1988).

One of the highest correlations in this study ($r = 0.815$, $\rho = 0.000$) is between overall cognitive engagement and valuable learning experiences. This may be interpreted that respondents with higher cognitive engagement scores are highly likely to be those who perceived the club activities as valuable learning experiences. The one outlier represents a gifted member who thrived on science challenges and in fact, wanted more learning experiences from the club. He was also a member of my other science ECA and suggested that SSWK could have included these components as well:

> Perhaps a problem solving team, maybe tackling a local scientific issue and working to provide solutions. I have found that young scientists are more likely to try something to see if works, because they haven't been tainted with scientific dogma. In science olympiad, we actively did this more for competitions. (49)

Thus, the data still tend to support this finding.

Survey respondents made 176 (33% of all cognitive engagement responses) references to the valuable learning experiences of the club activities. As shown in Table 7, the most memorable aspect of participating in SSWK was the rewarding experiences. Private school members and male members were more likely than public school members and female members to report valuable learning experiences. One-year members made the most comments about valuable learning experiences. Somewhat surprising is the absence, not fewer, but absence of any comments about valuable learning experiences from non-Caucasians and three-year members. Similar responses results when respondents were asked what they liked about the club. Males now made fewer comments than females, but non-Caucasians and three-year members still made no comments about rewarding or valuable learning experiences. Former Whiz Kids described these valuable learning experiences in comments like these:

- It was a great learning experience for me. (50)
- Not only was it fun, interesting, educational. But it showed younger kids that you could do educational tasks and have a good time. (46)
- It was a fun and rewarding experience- definitely a new spin on how to think about science and how to get kids interested in science. (40)
- I really enjoyed school so it would be tough to impact that but as I said previously other than sports, I wasn't in a bunch of clubs/groups. So this was really something that connected with me or I wouldn't have stayed in it. (82)
- I definitely grew more confident in my communication skills and became a better presenter, as far as speaking clearly and with enthusiasm and learning how to involve the students in a meaningful way. (19)

Another respondent explained his persistence and commitment this way:

> When I think of a short list of positive memories from high school, Suzy Science is usually in the top 10 things that will come to mind. I was back in {my hometown} over Christmas and as we were reliving old memories, one person mentioned, "Remember when we dressed up and had to discuss science projects as part of Suzy Science and the Whiz Kids?" We all had a good laugh and began to jibe each other about the costumes, but overall, they were positive memories. Suzy Science was one of the many experiences that helped me bond with other students who remain friends to this day. In that way, I believe it did have a positive significant impact on my overall high school experience. (22)

Rewarding, Worthwhile Activities. Cognitive engagement entails working on projects that students perceive as being worthwhile and the community service component of SSWK was valued by students. There is a moderate, significant correlation ($r = 0.445$, $\rho = 0.003$) between rewarding, worthwhile activities and attendance, meaning that as former members perceived club's activities as being more rewarding and worthwhile, then they were somewhat more likely to indicate greater attendance and involvement. There is one outlier whose scores exceeded the club pattern. This former member showed high attendance and involvement as well as voicing the rewarding value of the club's activities: "I feel I was quite diligent as far as my participation in and preparation for the program and its activities. . . .I found it rewarding to help others find the fun in learning." (37) The data still tend to support this finding.

Just as weekly religious participation is highly correlated to involvement in community service four years later (Hart, 2005), the same finding may apply for these dedicated members of SSWK. Survey respondents made 85 (16% of all cognitive engagement responses) references regarding their commitment to community service. Their comments included the following:

- My dad did experiments like that for me when I was little so it felt like giving back. (50)
- I think it was a way for younger kids to see highschool students who they looked up to make science seem cool and exciting. I think it was a way for highschoolers to give back to the community by making young kids excited about learning. (90)
- The opportunity to serve others in a way that suited my talents. . . .Involvement in something positive in our community and schools. (52)
- I just had a great time with the other students, having fun and teaching the young kids about science. I think it was a very rewarding experience. Outside of athletics, it was one of the best experiences from high school. (48)
- It [SSWK] was fun, fulfilling, and educational. (40)
- It felt as if you were doing something good for something else, so from a service learning angle, it was rewarding. (2)
- Being at other schools with younger children was a learning experience in and of itself - it was very rewarding to know that we

were helping expand the minds of kids who were in many ways less fortunate that us. (39)

- It is another example of how community involvement can be fun and rewarding. (88)

One member explained its value to her this way:

> It provided a different and completely unique way to approach education and committee [*sic* - community] service. It wasn't like any of the other programs I participated in, in that it was fun and little whacky while based completely in learning. . . .Community service, volunteerism and furthering other children's learning experiences are all important. A true education should be well-rounded and offer a variety of opportunities. It seemse bizarre that in a system which requires some form of P.E. for all students, even the most un-athletic, a volunteer program that fosters learning and sharing of knowledge would be critized. Regardless of what motiviates students to sign up, the students do participate and that's what's important. (37)

Cognitive Engagement in SSWK: Benefits

Academic Achievement (Science Knowledge). The major and most frequently reiterated benefit of cognitive engagement for ECA participants is increased academic achievement (Darling, Caldwell & Smith, 2005; Feldman & Matjasko, 2005; Gerber, 1996; Gifford & Dean, 1990). Without high school records or access, measures of academic achievement for SSWK members in this study rely on self-ratings regarding skill mastery of science concepts as perceived increases in science knowledge, scientific attitudes, perceptions about elementary children learning from them, and a expressed need for more inquiry in schools.

Academic achievement as a benefit of cognitive engagement was first measured by self-ratings of mastery of skills and knowledge. Some studies contend that ECA participants are already more motivated, interested and invested in schools than non-participants (Marsh, 1992). Based on 109 remarks (20% of all cognitive engagement comments), these Whiz Kids affirm that their participation in the activity developed these values and aspirations in them, not their beliefs held prior to participation (Darling, Caldwell & Smith (2005). As shown in Table 7, gender was not a distinguishing factor with respect to increased science knowledge. Increasing longevity shows the greatest increase in science knowledge, meaning that the longer members stayed in the club, the more likely they were to indicate increasing their science knowledge. Public school members and Non-Caucasians showed slightly higher increases than their counterparts, with little or no differences due to gender. Here are their thoughts about the changes in their science knowledge levels:

- I learned a tremendous amount about being in front of an audience, engaging them, making they come alive with what you are presenting and leaving a lasting effect. I learned about what it means to be an effective teacher. I learned that science can be magical and mysterious and fun. (5)
- I found that I learned better when I could get my hands on something and wanted to pass that idea along. (29)
- Also, explain[ing] my demonstration to others helped me to understand the concept. (15)
- Understanding why the demonstrations worked was essential to being a good presenter. As a result, we learned the science behind our demonstrations. (7)
- I definitely learned things in the club that I didn't know before. (3)
- Not only did I get out of school but I was able to share something I learned with others that hopefully made a difference in their life. (56)
- I remember it was like enrichment to the coursework I was taking, applying what I learned one step further. (60)
- My expectation was to have fun and to work with kids. and i got to do both of those. and unintended side effect was I learned to speak in front of peole more easily. (83)
- I felt like I learned some basic things in Suzy Science and it made science more understandable and much more interesting. (92)

Many former members have similar perceptions that all scientists are male, wear white lab coats, only do experiments and especially, that they are weird, boring, and work alone (Painter, Tretter, Jones & Kubasko, 2006). Here are some comments from the females about how their beliefs held prior to being a member of SSWK changed due to their participation in the club:

- It made things that seemd so complex, more simple - science really was within peoples' grasp. (39)
- Yeah, it made me believe that even I could do science. (32)
- I recall attending all meetings and trying to put forth a feeling of excitement to the young students we visited. (16)
- We worked well together, teaching each other our tricks and giving each other ideas on things to try to make our presentation more interactive and fun for the kids. (45)
- I'm sure my knowledge of science was increased through club participation. . . .One thing I can say is it reduced my fear of science. (62)
- They [new members] need to learn a few experiments and thoroughly understand the scientific theory behind it in order to explain it on children's terms. And that the whole this [thing] is supposed to be fun. (50)
- The may [*sic* - main] purpose of my character was to reach out to those that didn't care for science and make it relatable and fun. A skill I learned in Suzy Science and I carry with me to this day but in relation to history. (54)

Male respondents described how their beliefs held prior to SSWK participation changed:

- For the school age children, the demos can help them understand that there is interesting science to learn about in an approachable way. (91)
- I do remember the costumes and the fun people had making kids excited about science." (71)
- I tried to make science exciting and fun. (85)
- In fact, some of my most memorable experiments didn't work at all but were successful because the kids loved it. What mattered at the end was having fun with the students and creating a buzz of excitement and interest surrounding science and the Whiz Kids. (80)

SSWK members were not given any science knowledge tests prior to enrolling in the club, nor have they been given any now. Thus, this study cannot offer any specific assessed support for out-of-class science learning (McLure & McLure, 2000) or for in-school science learning (Zuzovsky, Chen & Tamir, 1990). However, former members were asked to describe their perceptions of the impact that their participation in the club has had on their knowledge of science. Based on the survey answers, 74 (81%) of the respondents indicated that their knowledge of science increased due to their participation in SSWK, and in some instances, their continued enrollment in science courses. None (0%) of the respondents failed to answer this question, although 13 (14%) did indicate that there was little or no increase in their science knowledge and 4 (5%) cannot remember what impact their participation had on their content knowledge. There is a moderate, significant correlation between perceived skill mastery and increased knowledge of science concepts ($r = 0.417$, $\rho = 0.000$), where former Whiz Kids who self-rated a high level of skill mastery were somewhat more likely to be those who also perceived an increase in their science content knowledge. There are no outliers to contradict this finding.

Similarly, there is a moderate, significant correlation between overall cognitive engagement and increased knowledge of science concepts ($r = 0.400$, $\rho = 0.000$), where former Whiz Kids with higher overall cognitive engagement scores were somewhat more likely to be those who also perceived and expressed an increase in their science content knowledge. Those who were more cognitively engaged in the club perceived that they had learned considerably more science content while participating in the club activities. There are no outliers to contradict this finding.

Both males and females reported the same perceived increase in science knowledge, but it is interesting to note the amount of differences in the knowledge gains expressed based on gender, with females indicating more significant increases of complex concepts and with males acknowledging gains, but smaller ones or merely reinforcing prior knowledge. While there did not seem to be any gender disparities within the club or in the outcomes measured, it does appear as if there were different entry knowledge levels by gender (Hoffmann, 2002; Kahle, Parker, Rennie & Riley, 1993; Sadker & Sadker, 1993). Female former Whiz Kids described their knowledge increases in these comments:

- By practicing various experiments, I learned many different scientific principles and how to explain them in the simplist of terms. Not only did this help me in many college classes, but has come in handy in helping my own children understand science. (23)
- I took Chemistry in my latter years of high school, where before my participation [in SSWK], I don't think I would have considered additional science other than the basics that were required. (34)
- I went on to take advanced chemistry as well as a chemistry course in my under-graduate work in College. (82)
- I understood the concepts better after teaching them. (10)
- It made me more aware of the basic principals and reinforced them. Seeing and demonstrating some of the ground level foundations of science definitely made me more knowledgeable. (46)
- I got an A in physics. I was proud of my final exam. (14)
- It [SSWK] did increase my knowledge of science. I learned about lasers, black lights and other interesting things that I didn't know much about before. (3)
- I think by teaching and explaining experiments I remembered more information. I still recall most of the experiments today, and am able to demonstrate and explain them. (21)

Male former Whiz Kids described their knowledge increases this way:

- I recall that I had seen some things and had some concepts explained that I had never had before. (2)
- While we covered basic science principles in class, the club gave us an opportunity to see science practiced in unconvential and unusual situations. (41)
- Many of the activities involved chemistry or physics, which were weaker areas for me than biology. (65)
- By the end, we not only knew our own demonstrations inside and out, but we knew everyone else's as well. (20)

Some female respondents indicated things differently:

- Not in a broad sense, but my science knowledge was increased with certain demonstrations and why they did what they did (Such as "lemonade" and "grape" juice and why the colors changed). (4)
- It was basic science that we had learned before. (83)

Some male respondents thought differently about the content knowledge:

- I thought that my part in the club was very easy, and I enjoyed teaching it. (38)
- Maybe a little [increase in knowledge]. (77)
- Only within the narrow scope of the demonstrations I was prepared to present. (91)
- Not really. The concepts were very basic. (24)

Scientific Attitudes. Survey respondents were also asked to rate themselves on the degree to which they believed that they possessed the certain scientific qualities based on

Table 8. Scientific Attitudes with Average, Minimum and Maximum Respondent Ratings on a Scale of 1=Seldom Evident in Me to 5=Consistently Evident in Me

Science Attitude	**Rating**	**Min.**	**Max.**
Ethical behavior, integrity	4.40	3	5
Belief in cause and effect	4.31	2	5
Intellectual curiosity, inquisitiveness	4.29	3	5
Respect for views and opinions of others	4.10	2	5
Communication, cooperation with others	4.01	2	5
Warmth, empathy, and humor	4.01	2	5
Open-mindedness, flexibility	3.98	2	5
Organization, efficiency	3.95	2	5
Imagination, creativity	3.85	1	5
Objectivity	3.82	3	5

a scale of 1 to 5 where 1 means the characteristic is seldom evident in them and 5 means the characteristic is consistently evident in them (see Table 8). Self-ratings are characteristically high (Xie, Mahoney & Cairns, 1999) and the ratings by these respondents reflect a very high confidence level. Data analysis show no correlation between years in the club and attitude ratings, indicating that club longevity was not necessarily related to higher scientific attitudes scores. Individuals can increase their science knowledge but not necessarily improve their scientific attitudes at the same time.

As shown in Table 8, there is little, if, any difference between scientific attitudes composite scores among all the groups monitored. There is a strong significant correlation between respect for the views and opinions of others and open-mindedness and flexibility ($r = 0.721$, $\rho = 0.000$), which means that former members who rated themselves higher on respect for the views and opinions of others were highly likely to be those who ranked themselves higher on open-mindedness and flexibility. There are no outliers in the data to contradict this finding.

For other scientific attitudes, there is a weak correlation between organization and efficiency and behavioral engagement ($r = 0.396$, $\rho = 0.000$), meaning that former members who rated themselves higher on organization and efficiency were somewhat more likely to be those members who had higher behavioral engagement scores. This may indicate that students who were more organized may have been better able to manage time and their studies so they could participate in ECA. There are no outliers to contradict this finding, either. Responses on respect for the views and opinions of others show a weak correlation ($r = 0.263$. $\rho = 0.011$) to the behavioral engagement component of working well together, meaning that those who rated themselves higher on respect for others may likely be those who spoke of working well together. There are no outliers to refute this finding.

Learning by Others Recognized. While there are direct measures of science learning, these have not been a part of the SSWK program. However, these high school students were placed in teaching positions from which they could make informal observations and decide for themselves the extent of the science learning by the elementary children. Many of the former Whiz Kids described how they modified their presentations to enhance learning and increase engagement of young children. To know whether young children were engaged and had learned the science concepts presented requires higher level thinking and metacognition, of what it means to ‘know’ something. I am curious as to how or on what the Whiz Kids, without any formal training in this venue, had based their decisions as to whether the children in their audiences were engaged and learning, how they decide what strategies to use to improve the situation, and to find out what evidences they used for their decision-making.

Seventy-five former Whiz Kids (82%) responded overwhelmingly that they had successfully engaged the elementary school children in their presentations. As shown in Table 7, public school members, female members, Caucasian members, and members with more years in the club were more likely to perceive their successful engagement of the children than private school members, male members, non-Caucasian members, and one-year members, respectively. Three-year members verbalized the most success and gave the best and most consistent evidence that the children were engaged and learning during their presentations. More female members than male members reported successful engagement of the children. Non-Caucasians offered much better evidences of learning than their counterparts.

As evidences of learning, 12 respondents (13%) cited the children's attention and engagement, 7 respondents (8%) cited facial expressions and exclamations, and 49 respondents (53%) cited the children's actions of offering help, asking questions, suggesting explanations, performing the experiments themselves, and writing letters to the Whiz Kids about what they had learned. The dominant response, "The children asked questions," was given 29 times (32% of the respondents). Twenty-five to ten years later, here are the evidences of elementary school children learning, according to these former Whiz Kids:

- The way the kids sat up and listened when we walked into the room and then the way they were excited about asking questions after our presentations showed me they were interested and paying attention. (35)
- I recall the children becoming excited over certain demonstrations, asking questions- and then explaining themselves why certain things were happening. (40)
- The particpation level (73)
- What the teacher said and what they wrote in fan mail (69)
- Many kids would raise their hands enthusiastically to make hypothesis, or answer questions. (23)
- I overheard on more that one occasion as we were in the hallway that the kids were discussing with another teacher or principal that they got to make paper airplanes and that they air made them fly (from a younger grade). (8)
- They were very enthusiastic and to me, when you are able to get children enthusiastic about a subject, they are learning somethign.(54)
- They would ask questions and want to answer the questions as well. And later you could hear them talking about what they had learned to each other or with their teachers. (71)
- Recieving thank you letters afterwards that had illustrations or descriptions of our experiments. (90)

One former member described it in more detail:

> Further, there is an instant bond when a teenager walks into a room of kids which is unlike when an adult walks into the room. The expectations are different. The kids probably have older siblings and can relate to a

> younger person. Then to have that person do all kinds of cool experiments and stuff. It brings in the WOW factor. It's that excitement and enthusiasm for learning that parents and teachers want to achieve. I think we did it because the kids could relate to us. (80)

Not all of the former Whiz Kids agreed that the elementary school children were learning something:

- I don't know that they did; I think the high school students learned more in the end. (12)
- It depended on the age of the child and the experiement. (59)
- Can't give you any [evidence], we should email them [the children]. :) (65)
- My recollection is that it kind of depended on the day and the group of kids. I don't remember a consistent pattern. (24)
- Some were very bad presenters and did not engage the kids, it is important to really like kids. (72)

One former Whiz Kid who is now in education questions the amount of real learning:

> As an educator currently, I'm probably overly critical. It's difficult for a teenager to know the difference between engaging students and getting students excited. There's definitely some overlap in that Venn diagram, but there are areas that don't overlap. I think we got students excited and sometimes engaged them. I also think we were doing some interesting hands-on "kitchen" science at a time when you saw less of that in an elementary school classroom than you might see today. Not being in a position to follow up with those elementary students, its difficult to say how much of that transferred. (2)

One Whiz Kid who was not a survey respondent once offered different evidence of student learning. On one of our first school visits that year, Sammy Soccer walked disgruntled out of his first classroom presentation and said that this wasn't any fun! I was taken back by his response to the first visit and probed further. It seemed that the elementary school children already knew his demonstration and in fact, knew it better than him and had corrected him on something. Then he continued that the children told him that Julie the Judge had done this same demonstration for their class last year, so they already knew it. Sammy Soccer had not practiced his demonstration as much as I had encouraged him to do so, but after hearing this from the children, he realized very quickly that he needed to know his experiment and know it well to present it to children. Of course, I tried to avoid visiting the same schools in consecutive years from then on as well. But as a teacher, I pondered the extensive preparations I'd made for my classes, the worksheets and activities I'd designed in order to help students learn concepts. Yet here it was, a year later, the young children were reciting a demonstration back to a new Whiz Kid and doing it better than he was, and doing it with no practice, repetition, worksheets, or prompting. Several questions surfaced on many levels that day.

Need for More Inquiry Learning. Although no questions were asked regarding the importance of inquiry learning, several former Whiz Kids were quick to press for the inclusion of more inquiry and discovery learning in current science classes. "I remember enjoying being in the club because it was fun to get younger children excited about Science. It caused children to ask the question, "Why does this happen?"" (66) Another member brought home this finding:

> The presentations [by SSWK] sparked inquiry and questions. The students [elementary children] wanted to participate, and they wanted to discoverer how the demonstrations worked. As presenters, we were practiced at explainging the science behind the demonstration. Students learn best through inquiry-learning, and the demonstrations sparked inquiry in the elementary school children. . . .Through previous jobs and experience, in middle and high school, I had known that I liked working with younger children. However, this club gave me the opportunity to experience how much excitement and awe science could inspire in younger children. Currently, I am a middle-school science teacher, and I still enjoy conducting inquiry-based learning in my classroom. I volunteer my Spring Break and time throughout the year conducint fundraiswers so that another teacher and I can take a group of about 90 middle-school from our district to Space Camp in Huntsville, Alabama. Both these positions [hers and that of the other teacher] are unpaid. (7)

Many of the former Whiz Kids' responses reflected their current positions as parents, teachers and users of science knowledge. Students with high ECA levels may have enjoyed greater achievement levels than the levels prior to their participation (Camp, 1990), a concept that many respondents voiced in their comments. It would be interesting to investigate if the benefit for cognitive engagement in ECA, academic achievement applies equally as well for members who participate in ECA that leave the school during the day.

Cognitive Engagement in SSWK: A Summary

The second component of engagement, cognitive engagement was exhibited by SSWK members in several ways. The first was intentional decisions and strong commitments to join and to remain as loyal members of SSWK, with reasons primarily based on the concept of fun, interest in science and teaching. Former Whiz Kids practiced diligently to master concepts and skills, to increase their visualization skills in science, and to accept new challenges. They frequently went beyond expectations to perfect their presentations, both individually and collectively as squads. Former members perceived they had persisted toward life goals and that they valued the activities. These measures as well as their academic achievement, as evidenced in increased science knowledge, highly-rated scientific attitudes, and promotion of more inquiry in schools, validate their ardent cognitive engagement in SSWK.

Members with higher cognitive engagement scores were

1. very highly likely to perceive the club activities as valuable learning experiences;
2. highly likely to have a higher overall ECA engagement score.
3. highly likely to persist beyond expectations, e.g., practicing their demonstrations;
4. somewhat more likely to enjoy the challenging situations in the club;

5. somewhat more likely to improve their demonstrations;
6. somewhat more likely to have made changes to improve their squad presentations;
7. somewhat more likely to perceive learning more science content knowledge;
8. somewhat more likely to equate costumes with getting children's attention;
9. somewhat more likely to have more consistently considered POV of others;
10. likely to have described their most memorable moments on the survey; and
11. likely to have joined the club for reasons other than to get out of school.

Former members, who showed higher cognitive persistence, i.e., exerting effort beyond expectations, working toward goals, were

1. somewhat more likely to perceive club activities as valuable learning experiences;
2. somewhat more likely to make changes to improve their demonstrations;
3. somewhat more likely to enjoy challenging situations in club activities; and
4. somewhat more likely to work with their squad to improve the squad presentations.

Table 9. Summary of All Cognitive Engagement Responses

Coding	EC	EE	EL	EM	EP	ER
Variables	Challenge	Experiences	Life goals	Mastery	Persistence	Reasons
Total # of Responses	7	76	5	09	2	6
Percent of Responses	3	3	6	0	3	

Cognitive Engagement in SSWK: Regression Analysis.

The cognitive engagement variables were identified in former members' responses and coded following the coding schema and then tallied to give survey respondents a score for each variable of cognitive engagement. Adding together all the scores for these variables generated an overall cognitive engagement (CE) score for each participant. The final tally of all the cognitive engagement variables is shown in Table 9. The 535 responses coded as cognitive engagement (CE) constituted 20% of all survey engagement responses.

In analyzing the responses from the former Whiz Kids, overall cognitive engagement shows a strong correlation ($r = 0.760$, $\rho = 0.000$) with overall ECA engagement with no outliers in the data to refute this finding. A multiple regression analysis for overall ECA engagement and cognitive engagement as measured by intentional reasons, persistence of effort, challenges, worthwhile learning experiences, working toward life goals, and skill mastery yields $F_{(6, 91)} = 21.762$, $\rho = 0.000$, reiterating a strong correlation ($r = 0.778$). After correcting for interaction effects ($r^2_{adj} = 0.606$), this analysis shows that 57.8 % of the variance in overall ECA engagement can be explained by these six cognitive engagement variables. Thus, this data tends to support the assertion that cognitive engagement is an important component of ECA engagement (Fredricks, Blumenfeld & Paris, 2004).

Emotional Engagement (EE) in SSWK: Introduction

Emotional engagement sheds light on the participants' responses or reactions to the influences and interactions with concepts and people during ECA activities. The emotional engagement (EE) of the Whiz Kids is evidenced as they described their most memorable moments, in their interests and attitudes toward teaching and science, in their emotional responses to the activities and costumes, and in their school spirit (ties to the school), as well as their responses and interactions with peers, parents and teachers. From the literature review, benefits from emotional engagement include increased interpersonal skills, social networks, positive attitudes and connectedness. An overall emotional engagement score has been assigned to each participant based on the sum of the individual emotional engagement measures.

Table 10. Basis for Most Memorable Moment, Number of Responses, and Percent Responding

Basis for Memorable Moments	No. Responses	Percent Responding
Teaching/Kids Excited	55	60
Doing Science	40	43
Fun, Exciting, Cool!	40	43
Elementary Schools and Teachers	30	33
Wearing Costumes, Performing	26	28
New Friends, Part of Group	19	21
Performing Commercially	13	14
Rewarding Experience	11	12
Being with Friends	10	11
Working with Sponsor	8	9
Other (of individual nature)	53	58

EE in SSWK: Evidences

'Flow'. 'Flow,' a term that depicts high emotional consciousness that engages individuals at high levels of concentration to the point of timelessness (Csikzentmihalyi, 1988) seems an apt description of the emotional engagement of the club members and their sponsor as well. Contacting these former students after all these years has been an

effort of delightful reconnections, of time standing still. In a similar sense, “Brigadoon” was here again, just one day later, not twenty years. As if no time had passed since our last meeting, we broke into the same relaxed casual and open conversation we had enjoyed years ago. One member stated that since he was middle-aged and we were now nearly the same age, he guessed that he could call me by my first name now. (His next sentence started with the familiar, but more formal address, “Mrs. K”.) His sense of time (or of uniform aging) was on a different scale than normal, more Brigadoon-ish.

‘Flow’ occurred during the years of the club’s operation. Whiz Kids worked diligently on their school visits, moving from one room to another, even visiting extra classrooms when teachers requested more or special presentations. To this day, no one has asked or noticed that bathroom breaks or time-outs were never given during school visits. My reasoning was that there would be nothing for high school students to do at an elementary school with no room in which to hang out and most of the furniture was too small for some of the bigger Whiz Kids. Perhaps it was the fear of the old adage about idle hands making mischief that kept us on a tight schedule or that we simply had too many classrooms to visit in a short time period. But the fact that no one noticed this omission must be due to ‘flow.’ ‘Flow’ must also account for the fact that none of the respondents in the survey remember that most squad practices occurred at 6:30 AM in the morning to avoid conflicts with sports teams practices after school. Time and space just have different dimensions in “Brigadoon” and for SSWK.

Most Memorable Moments. These former Whiz Kids were asked to describe their most memorable moments in the club. Two (2%) did not respond and 4 (4%) could not remember. The rest of the respondents gave 1-8 responses with an average of 3.3

responses about their most memorable moments. Each of the most memorable moments for these respondents was coded, using the coding schema. Correlations, however weak, exist between the memorable moments with all three engagement components; that is, behavioral ($r = 0.225$, $\rho = 0.031$), cognitive ($r = 0.306$, $\rho = 0.003$), and emotional ($r = 0.294$, $\rho = 0.004$) engagement. The bases for the most memorable moments that the respondents described are categorized and summarized in Table 10.

When asked to describe their most memorable moments in SSWK, former Whiz Kids shared these valuable glimpses into that point in time for them:

- I remember working with elementary-aged children that were excited to learn from high school students, rather than their teachers. (1)
- Only one time did I get the "cubic bubble" in the shape of a cube to form the cube in the middle. The kids were so in awe. (8)
- Bringing Alpha and Beta (the two guinea pigs) to a kindergarten class and letting them loose on the floor amongst a circle of excited children and explaining behavior to them. (12)
- I loved getting "fan mail" from the kids at the schools where we visited. (19)
- I remember going to the science center which was very cool! And performing for younger kids in grade school or middle school. My experiment was with a popcorn maker. (32)
- I remember doing an event at the {local} Science Center, and it was a blast! (59)
- Watching elementary school kids begin to understand how electricity works and seeing their excitement to learn more about science grow. (33)
- My most memorable time was a trip to the Science Center w/ the Whiz Kids where we put on a demonstration for children. (40)
- 1. Wearing the hershey kiss costume and having kids be excited to see me 2. doing the experiment of having a chalk peice drop into a bottle. (90)
- Running the static electricity ball (Van DeGraff Generator -- I just had to look it up). (55)

One memory recalled a stressful time for the club that impacted the entire high school: "Two stick out: one was the time we got stuck at a grade school during a snow storm and had to get back to the high school. The other was performing my character in front of my sister's gradeschool class.” (54) I remember that day as well. Our club had left for a scheduled grade school performance and upon arrival at the elementary school, had started making our rounds to the classrooms when the elementary principal found us and told us we’d have to leave, and leave immediately! The ominous looking sky had suddenly started dumping big buckets of snow and the high school was closing early so the buses could still get students home safely. That is until the administrators realized that all their students were not in their places. SSWK was still at the grade school! Collecting squads, supplies and personal belongings was done in a scramble as we hurried back on our bus and headed back to the high school. But the roads were already getting treacherous. The high school called the bus twice on the district radio, demanding to know what was holding us up, that they were holding all the buses for us. The bus driver calmly told them we would be there as quickly as possible. Our club was now holding up the entire district from being dismissed early! The elementary school children cannot be sent home until the middle school students are sent home; the middle school students cannot be sent home until the high school students are sent home; and the high school students cannot be sent home until we get back to the high school. What seemed like hours later, we arrived safely back at the high school and all the students were sent home promptly. The next day all the buzz was about how that stupid science club kept all the students at school when they could have gone home early because of the snow! We have shared several memorable moments together; some better than others!

Other respondents shared these special moments:

- Perhaps the most memorable and odd situation was when Suzy had split the bottoms of her outfit. We were doing the trash can lift that talked about center of gravity being different in boys and girls. The girls could stand back-up but the guys couldn't. One class kept asking her to demonstrate again and again. We couldn't figure out why. Then the teacher in the room noticed and pointed it out to us and we changed up the presentations that day because of it. (29)

- I really got a kick out of seeing the kids reactions to the corn starch and water 'experiment' I would prepare and bring to the schools. Some were amazed, others had already seen this and even knew how it was done, nonetheless, I very much enjoyed that. As well as their reactions to our funny outfits. (77)
- Some of my memorable experience included having fun with my peers, going on fieldtrips teaching students how electricity worked, watching the person doing the lemonade stand change the lemonade's color by pouring it from one pitcher to another, and participating in International Day. (81)

Personal Interest in Teaching Children. In addition to memorable moments, Whiz Kids indicated their emotional engagement based on personal interests, such as their interest in teaching and working with young children. There is a moderate, but significant correlation between enjoying working with children and emotional engagement ($r = 0.547$, $\rho = 0.000$). This means that those former members who expressed more enjoyment in working with children were somewhat more likely to be those members with higher emotional engagement scores. The one outlier reinforces this finding to the extreme; she had the highest overall emotional engagement score and the highest score for working with young children. She explained her passion in this way:

> In high school, I enjoyed science and I enjoyed teaching younger children, and this club gave me the opportunity to do both. I appreciated that the club brought together other students who also shared my interest in science and gave us the opporuntiy to participate in an activity where we enjoyed the rewarding experience of sharing science with children. (7)

There is also a moderate, significant correlation between enjoying working with children and their overall ECA engagement ($r = 0.411$, $\rho = 0.000$). This means that those former members who expressed more enjoyment in working with children were somewhat more likely to be those members with higher emotional engagement scores as well as having higher overall ECA engagement scores. There is one outlier to this finding, a member who scored high on overall ECA engagement, a dedicated member who just focused more of his comments on what he experienced in the club with regard to the content and with other high school students: “It was a chance to showcase science and how much fun they could be. There was more to the book aspect of science and that you really could get your hands on the stuff and do it.” (29) This outlier still tends to support this finding. Teaching and working with young children seems to have appealed to this former member who as an adult, chose teaching as a career. He just enjoys working with older children and is currently a high school teacher:

> Well I am a teacher now. I have been pretty comfortable in front of a crowd discussing something. Fo4 5 years I worked for the Boy Scouts and would have to stand in front of people in the scout uniform and some would laugh at first but I didn't care because I have worn costumes before in front of crowds. I am a big goofball now in front of my classes. (29)

As shown in Table 11 and stereotypical expectations, female members expressed more interest in working with children than male members did. More surprisingly, private school members, three-year members and non-Caucasian members showed much greater interest in teaching and working with children than their counterparts. Former Whiz Kids expressed their interest and enjoyment in working with children like this:

- I had a great time inspiring younger children to enjoy and learn about science and related activities. (17)
- The grade school activity was fun. I remember the joy it brought to the young children. (27)
- I love children, and always have loved working with them. (59)
- [I loved] Seeing the kids laugh and hearing them oo and ah. (85)
- I have a great passion for teaching. This may stem from these early experiences. (6)
- I've always been a teacher at heart and this was a natural outlet for me. (61)

Table 11. EE Variables, Survey Response Percentages Disaggregated by School, Gender, Race, and Longevity where School: A = Public; B = Private; Gender: F = Female; M = Male; Race: C = Caucasian; NC = Non-Caucasian; and Longevity: N = Years in SSWK

Variable	School		Gender		Race		Longevity		
Values	A	B	F	M	C	NC	1 Yr.	2 Yr.	3 Yr.
Teaching Kids	47	63	54	48	49	69	48	52	71
Science	32	23	28	32	29	31	30	25	57
Attitude toward Science	79	93	84	84	83	85	85	82	85
Hands-on science	19	7	11	23	17	6	15	15	14
Memorable Moment is Science	34	63	43	45	50	42	30	52	43
Liked Costumes	10	10	13	3	11	6	6	10	29
Costumes Memorable	24	37	31	23	28	31	30	25	43
Did not join to get out of school	53	70	57	61	58	63	61	58	57
Liked to get out school	10	3	8	7	8	6	12	4	14
Memorable Being with Friends	11	10	8	16	13	0	12	10	14
Liked Being with Friends	3	10	5	7	7	0	0	10	0
Memorable New Peers	26	10	21	19	21	19	24	19	14
Liked Being with New Peers	16	13	16	13	13	25	6	7	43
Parent Interest	3.6	4.0	3.9	3.4	3.9	3.2	4.0	3.6	3.7
Met Needs	4.7	4.3	4.7	4.4	4.6	4.7	4.6	4.6	4.7
Belonging	40	37	41	35	34	63	30	42	57
Impact HS Experience	3.9	3.5	4.0	3.4	3.8	3.5	3.9	3.7	4.1

Feeling Successful. Perceiving that they were successful in teaching children basic science principles also shows a moderate, significant correlation ($r = 0.400$, $\rho = 0.000$) with emotional engagement. That is, former members who perceived that they were more successful in engaging students in their demonstrations were somewhat more likely to be those members with higher emotional engagement scores. There are two outliers in the data. The first outlier tends to support the inverse of the pattern, in that those who felt less successful in engaging students in their demonstrations were somewhat more likely to be those students with lower emotional engagement scores. With one of the lowest emotional engagement scores, this member explained the reason he perceived for a lack of success: “Some children just weren't interested; their attention could not be held by the demos or the costumes.” (91) The second outlier represents a member who suggested that other factors, such as timing, influenced their effectiveness: “My recollection is that it kind of depended on the day and the group of kids. I don't remember a consistent pattern.” (24) Thus, the data still tend to support this finding.

In a similar manner, feeling successful was correlated to overall ECA engagement ($r = 0.449$, $\rho = 0.000$); those feeling more successful in engaging children were somewhat more likely to be more actively engaged in the club and its activities. There is one outlier in the data to this finding. The outlier is the member (91) who has already been identified for his perceived lack of success with elementary school children. Since the question asked for success in engaging *every* child, he simply responded with a low self-rating, since he knew he had not engaged *every* child. Based on possible confusion of the question intent and his interpretation, the data still tend to confirm the finding.

Personal Interest in Science. Their emotional engagement also reflected their interests in science. Using the coding schema, survey responses were examined and coded to determine the levels of the former members' interests in science. There is a moderate, significant correlation between interests in science and overall emotional engagement, ($r = 0.545$, $\rho = 0.000$), that is, former members who indicated a higher interest in science also were somewhat more likely to show a higher overall emotional engagement or to be more emotionally engaged in the club. There are no outliers in the data to refute this finding.

As shown in Table 11, interest in science did not elicit the same quantity of responses as interest in teaching children, perhaps indicating the club attracted many students already inclined toward teaching careers or reflecting the high percentage of members who did not like science. Non-Caucasian members and male members expressed interest in science only slightly more than their counterparts. Most surprising is that more public school members expressed interest in science than private school members. Three-year members expressed the greatest interest in science, meaning those who liked science stayed in the club longer.

There is a moderate, significant correlation between interests in science and overall ECA engagement in SSWK ($r = 0.486$, $\rho = 0.000$), meaning that former members who indicated a higher interest in science also were somewhat more likely to show a higher overall ECA engagement or to be more actively engaged in the club. There is one outlier for this correlation, representing the former member with the highest emotional engagement score who passionately described her engagement this way: "The club was an excellent opportunity to spend time with other students who shared a similar love of science and who enjoyed sharing science with younger students.” (7) Thus, the data still tend to support the finding.

Respondents made 121 references (10% of all emotional engagement comments) to their interests in science. Females offered these responses:

- I liked the idea of continuing to learn about science while sharing that knowledge with others in the community. (37)
- Wanting to learn more about the hard sciences. (55)
- To this day, I remember my friend's demonstration of Bernoulli's principle. I explained it to my son not too long ago. . . .I think I had more respect for science after I joined the club. As a teen, it was hard to connect science to everyday life but the presentations we did made the principles more "touchable". (35)
- I loved biology. I wanted to go into medicine or teaching. (I-16)
- I believe it enhanced my interest in science in that it showed science is in everything we do. It taught me science does not have to be complicated. (60)
- I was terrified of taking chemistry. The club really put a positive spin on it and made me want to work harder in the class. (63)
- Jesus very much used my participation in the club to increase my curiosity for the sciences, I never really saw before why science was so needfull, interesting, helpful, or how it could be fun, real. (76)
- My favorite subjects were science and math. I wanted to go into the medical field, but not nursing. I really wanted to go into pharmacy. [I remember that.] Yeah, I got a job after school when I was a senior working at a pharmacy by our house. When I graduated and went to school, my brother took over that job, too. He’s a pharmacist now, too and his wife is a pharmacist. (I-15)
- My favorite subject in school was science. I wanted to be a doctor or an environmental engineer or maybe, a chemical engineer. (I-9)

Males offered these responses about their interests in science:

- In addition to exploring science a bit more, it provided a good atmosphere to gain confidence and meet others. (41)
- I do love to learn about new science technology. (42)
- My most vivid memories are of the students to whom we presented and their awe at some of the real world examples we provided of how science impacted their everyday life. For many it seemed as they were for the first time realizing how exciting science can be and how these concepts they previously had only learned about in the classroom had concrete applications in real life. (62)

- My favorite subject in school was science, especially physics and biology. I knew I didn't want to be a teacher, but this club gave me an outlet to share what I knew with others. (I-8)

One male former member described how he was drawn to science in this beautiful prose:

> It gave me a sense that science wasnt something that you read or learned alone. It was something you experience. True research is based on creativity in the lab much the same as an artist and a painting. A painting will never be completed unless the painter picks up the brush dips it into the paint and strokes the canvas. Science is a bundle of theory, but does not materialize into practicality until the beaker and test tube are picked up and reagents are used. (49)

Attitudes toward Science. Contrary to another study that ECA may be indicators of students that are already excelling in a particular area and are just continuing with their interests (Chambers & Schreiber, 2004), several female respondents from SSWK reported initial trepidations about joining a science club (Painter, Tretter, Jones & Kubasko, 2006). Respondents echoed some of the misperceptions mentioned earlier, reporting their hesitations and uncertainties this way:

- My mom was surprised I wanted to do it because I never liked science, but I enjoyed being one of the Whiz Kids. (66)
- Can't say I'm much of a science fan. (82)
- I've talked about it since and been proud to have been a part of a science club considering I am less "math/science" and more of an "english" person. (33)
- I HATED science, especially biology! All we ever did was just book work! I got an A in chemistry, and in college, I got an A, but I hated it! (I-1)
- I had no previous background or interest in science. Prior to joining the club, my strengths were in writing and language. (20)
- Science is still one of my least favorite subjects to this day. (66)
- It [science] is still a difficult subject for me. (18)
- It gave me a better understanding of the subject matter and introduced me to the fact that science could be fun and entertaining. Something that I did not understand until I joined the club. (54)
- I grew to like it much better than when I started. I was initially afraid of science, it was intimidating to me because of the complexity of the topic. Breaking it down made it less scary. (45)

- My parents were supportive of all my participation in clubs and activities, and science was a club that was very subject specific - science wasn't my strongest subject in school so they were happy to see me branching otu. (39)

Females also indicated their hesitation in these comments:

- Well...I wanted to do what my friends wanted to do. They told me about this cool Science club, and I wasn't good at Science. They said it didn't matter. I was worried that the teacher would tell me no, because Science wasn't my thing. But the whole experience was very inclusive, and I learned quite a bit. Science is not boring! (45)
- Ms. Kralina was a great teacher, with infinite patience. I was not an easy person to engage, I frequently wrote notes during class, but she had some really fun activities, Suzy Science being one of them. Looking back that was a great science club because it was fun, social, and not stereotypical "dorky" science club. (14)
- It [my favorite subject] wasn't science! I liked you as a teacher, but my favorite subject was English!
  [Why did you not like science?]
  I felt I didn't have a good grasp of how things work. I felt like it was over my head. And that was a simply intimidating thing. I was an honor student and it was intimidating to have something that I felt was over my head. I still got A's in science. I think I got one B. My only B in high school was in science.
  [Feeling the way you did about science, why would you want to be in a science club?]
  Because of you! I loved you and you made science interesting. So I wanted to do it, anything you did, I wanted to be a part of. (I-7)

Some male former members echoed similar reservations about science:

- Frankly, I was never particularly interested in science -- I only took one course per year in high school and it was the one distribution requirement I skipped in college. (78)
- It [SSWK] made science less boring. (86)
- Because I'm not really a "science" person. I don't think I would have tried some of the things, if it wasn't for Suzy Science. (51)
- Many of the activities involved chemistry or physics, which were weaker areas for me than biology. (65)

As noted previously, science fair competitions dominate science ECA opportunities and even these are more class requirements rather than voluntary participation in ECA. While science fairs serve a vital function for children already interested in science (Eylon, Hofstein, Maoz & Rishpon, 1985; Simpkins, Davis-Kean & Eccles, 2006), many individuals including Whiz Kids cite science fairs as the reason why they do not like science to this day. A female former member offered this fact: "The only thing I ever remember about science fairs was making those boxes with my dad." (I-13) One respondent included his distaste for science fair in this comment:

> I was never a fan of the "science fair project" kind of science, where I'd have to go in on my own, think of some grand idea, execute the idea, and present it to the group in a competitive setting. I much prefer working as part of a group, and I was able to do this through Suzy Science. I am not the best at science (physics, biology, chemistry), and didn't take many more classes on such topics after high school. (22)

Despite these personal comments to the contrary, survey respondents were adamant in their assertions that everyone in SSWK loved science:

- I liked the comradery we formed as a group - 3 different grade levels and we all excelled in science. (8)
- We all like what we where doing and I thing it made us work better together. (31)
- It [SSWK] affirmed my already positive attitude toward science in that others in my school thought like I did: it's OK to be smart and learn. Let's face it, until the Science Channel came on the air, there were no role models on TV for science/ math junkies. It's all about athletes and popularity. The club "let us be us". (64)
- Suzy Science and the Whiz kids was a science club that was offered as an opportunity for students with an interest in science to extend that interest in a club activity. Because the practices were outside of class, students who participated in the club had to commit their time after school, demonstrating that our participating wasn't motivated in an interest in getting out of class. Instead, we were devoting time outside of school to our interest in science. When we did miss school, the expectations were that we had to catch up from that days missed lessons, notes, and assignments. This also required extra work and time for the participating students. (7)

In addition to their expressed interests science, Whiz Kids' responses indicated that their emotional engagement in SSWK also improved their attitudes toward science, according to 77 (84%) respondents, with 60 (65%), indicating a significant positive improvement. Every respondent answered this question, although three (3%) could not remember and 12 participants (13%) reported that their participation had little or no impact on their attitude toward science. As shown in Table 11, the percentages for the groups monitored appear consistent. Surprisingly, the group showing the greatest improvement in their attitudes toward science was the private school members. There are only weak correlations between improved attitude toward science with other variables, namely, overall ECA engagement, behavioral engagement, club routines and procedures, valuable learning experiences, training, squad cooperation and wearing costumes. Female respondents expressed their improved attitudes toward science in these comments:

- It reminded me then and even now as I fill out this survey that science is interesting and very cool and should be taught that way. (5)
- I always liked science, but this club made it fun. I know that sounds like a cliche, but it's true. (37)
- I became more confident in science and even began to like it more. (15)
- It made me enjoy science which I did not enjoy previously. I still remember many of the experiments and have told my kids about how fun science can be. (25)
- It was a nice way to learn something that doesn't come to me naturally or easily like other subjects such as history, english, etc. (55)
- I liked science when I joined the club but I loved sharing that interest with the younger kids. (28)
- I loved being part of Suzy Science. I liked going to other schools and making Science fun for younger children. (44)

Male respondents shared their improved attitudes in science this way:

- Yes, it showed that even the most difficult subjects could be learned if you have a good attitude and put the time into it. (74)
- It reaffirmed my interest in the world around me. (56)
- I tried new things and probably did more "science" related things during that time than any other. (51)
- I am still curious about science and I feel it is a crucially important thing to teach children. (71)
- I enjoyed it [science] more. (43)

- Instead of just sitting in a classroom or reading about things in a book, we actually were doing the experiments and educating others. It made science less boring. (86)

Male former members described their increased appreciation and attitude toward science:

- My recollection is that the demonstrations were based largely on basic scientific principals which were demonstrated through a hands-on approach. I think what I walked away with is an appreciation that not only could you understand these concepts, but you had to have an understanding of them to teach it to someone else. (That isn't a concept shared by all elementary teachers I have worked with in the past 11 years.) (2)
- The club affected my attitudes toward science in many of the same ways as it hopefully did for some of those elementary students. English and writing always came more naturally for me than science and math and consequently I didn't embrace science. The club certainly gave me a greater appreciation for science. (62)

One participant reported that her attitude toward science had only slightly improved because: "I saw the club as more peer focused over the educational aspect." (16) Another former Whiz Kid reported she only perceived a slight improvement because: "When I think of the things I enjoy and don't enjoy about science, I do not think those opinions were shifted much by the club. What it probably affected more was my attitude toward teaching and presenting." (26)

Impact of Gender. Researchers consistently cite gender issues impacting the emotional engagement, beliefs and career aspirations in science of female students (Baker & Leary, 1995; Hanson & Kraus, 1998; Kerr & Robinson-Kurpius, 2004). In sharp contrast to these studies, none of the variables measured in this current study show any significant correlation to the gender of the respondent. While this sounds negative, it actually is a positive spin in that females as well as males enjoyed this science club and its activities. The composition of the club was 67% females and 33% males. Females assumed leadership roles in the same proportion as the club composition.

In other words, females enjoyed participating in an academic club focused on science just as much as males. They enjoyed doing physical science experiments just as much as the males in the club, contrary to other studies (Debacker & Nelson, 2000; Lawton & Borders, 1995). They enjoyed learning more about science, even though many females initially registered some trepidation about joining such a club. Working with and teaching young children was the value added to the ECA and was one of the top reasons given for joining the club, as stated earlier. Several females indicated that it was only the influence of friends that persuaded them to join the club, but they reported that they stayed because they enjoyed themselves and found science was fun.

Females spoke enthusiastically about their participation in a science ECA:

- I think I had more confidence in my presentation and an added level of enthusiasm. (6)
- After the initial fear of the first demonstration, it grew easier to multitask and speak and think at the same time. I feel that the presentation would have been clearer, too. (12)

Male respondents spoke of their uneasiness dissipating as well:

- With the last presentation, I knew my demonstration extremely well and was easily able to change the presentation depending on the age of the particular audience. This was definitely not the case with the first demonstration. (20)
- I saw these much more as performances at the time, having done a fair amount of theater in high school. There's no question that my last "performance" or demonstration was better than my first. I was much more comfortable and at ease, not only with the concepts I was conveying, but also at communicating them with the younger students I was speaking to. (2)

Emotional Responses. In addition to memorable moments, interests in teaching, and interests and attitudes toward science, emotional engagement also deals with the individual emotional responses to the club, its activities and the experiences of its members. The coding schema allowed respondents’ answers to be coded for general emotional responses to the club and an emotional response score to be determined. There is a moderate, significant correlation between emotional responses and emotional engagement ($r = 0.598$, $\rho = 0.000$). This means that former members with a higher emotional response rate were somewhat more likely to be those with a higher emotional engagement in the club. There are no outliers in the data to contradict this finding.

There is a moderate, significant correlation between emotional responses and overall ECA engagement ($r = 0.567$, $\rho = 0.000$). This means that former members with a higher emotional response rate were somewhat more likely to be those with a higher overall ECA engagement level. There is one outlier in the data. This former member had the highest emotional engagement score and the highest overall ECA engagement score. His high scores were not based on general emotional responses, but rather specific emotional responses directed toward his friends in the club, the club activities, and the personal joy he perceived due to his participation. He shared this insight:

> It sounded like a fun idea and a more interesting way of getting involved in teaching science than getting stuck in the math or having to deal with pipetting from Chemistry or some other aspect of science that I didn't enjoy. And in the end, dressing up in funny costumes and getting to laugh at your close friends about how silly you all look (and then taking a group picture so that it's saved for posterity) is always fun. The project drew in fun personalities, and I think that had a positive effect overall since, as more fun people joined, them more others heard about it and then also wanted to join to bring their fun personalities into the group. (22)

Thus, the data still tend to support the finding.

In all, a total of 346 (28% of all emotional engagement comments) responses were made as emotional responses to the club, its activities and the experiences in general. Their comments included in previous sections affirm the range of emotional responses experienced because of interactions with young children, science activities, peer support, camaraderie and connections with club sponsor. They enjoyed the elementary children's reactions to their presentations:

- It was fun to be silly in the classrooms and be so popular with the young kids. (11)
- In fact you got to be a "celebrity" as many kids would recognize you out of costume in public and begin to ask about your experiment and tell their parents all about the school's visit. (23)
- Elementary school kids are like sponges for cool science stuff and that's generally what I recall Suzy Science being about. (78)
- The children were totally engaged in what we were doing. We had fun and that made the children have fun, too. (84)

They loved getting letters and cards from the elementary children after their presentations:

- I remember the letters we received after our visits with all the pictures they drew. I stll have a few of those letters in my high school memory book. In my early years of teaching, I had students who remembered me as Suzy. (5)
- I remember receiving letters from the kids with a rabbit (which was my favorite character). That always seemed to brighten my day. (25)

Some relished the camaraderie within the club itself:

- I loved the fun and friendly atmosphere - it was consistent and there was never any pressure. It made learning fun for everyone involved. (84)
- Suzy Science and the Whiz Kids continues to be one of my favorite high school memories. Thank you for the opportunity to relive those experiences. (23)
- I only recall happy memories. I'm not a joiner typically but really enjoyed this and have fond memories of the time. (82)
- I am proud to have been a part of such a fun, generous, educational undertaking. (33)
- This was one of my best extracurricular activities, probably tied with teaching a foreign language to children in school. I just now remembered getting fan mail - that was pretty cool too. (11)

Many enjoyed doing more things with science:

- It [SSWK] helped me realize that science can be fun! (84)

- I found this [SSWK] made me love science more. (31)
- Science was always my favorite subject, but not my best. This was a fun way to learn, interact, and encourage others to engage. (40)
- In your first demostrations you are so nervous and fumbling through every line. By the end you were comfortable and just excited to be showing the kids a science experiment. The club brought science to life in fun ways. (28)

Some gave an emotional response of personal growth and meaning:

- I felt valued. I had an interesting presentation and the younger students were interested and wanted to try swinging the water glass around on a string. (14)
- I was fortunate to have the enriching experience. I gained a deeper understanding of scientific information with enthusiasm. I always enjoyed the club and activities. . . .I have fun pictures, even with you dressed up. I still have the letters from students and you. Much of my high school box is full of memories from the club. (21)
- All in all, the experience was very good. I had other "itches to scratch" so to speak, but the club was a good outlet and felt like the right thing to do (helping others). (61)

Some gave less enthusiastic responses:

- I remember being pretty shy in the face of the whole thing, and was surely less enthusiastic and engaging as some of the other Whiz Kids. (75)
- I can only remember being terrified the one time I had to perform. I don't do well in front of an audience, especially when I am not prepared. (18)
- I don't remember ever regretting joining the club. I wouldn't describe it as a defining moment of my high school career, but a club that fit in nicely with my personal aspirations at the time and that I was happy with. (2)

Wearing Costumes. Of particular interest is the colorful costumes that added an emotional factor of fun for most Whiz Kids. Just to clarify, all costumes were limited to colorful, cheerful, upbeat characters. There were no scary characters, not even a mouse, since some elementary school teachers had told me that their students were scared of rodents and insects since some of their homes were plagued with these creatures. So the advertisement flyer boasted that SSWK does for elementary science what Electric

Company and Big Bird do for the alphabet. As shown in Table 11, overwhelmingly, three-year members liked wearing the costumes 3 to 5 times more than any other groups of members. The Whiz Kids loved wearing the costumes:

- [What I liked best was] Mrs. Kralina's enthusiasm. And, I must admit a penchant for costuming... (26)
- First year I was a French Maid and I was whistled at by 1st graders !! I never laughed so hard in my life. Needless to say next yr I was a clown! (89)
- It was fun to dress-up and spend time with my fellow classmates. It was rewarding to see how excited the audience was to watch our demos. (88)

There is a moderate, significant correlation ($r = 0.430$, $\rho = 0.000$) between costumes and emotional engagement. Those who enjoyed wearing costumes were somewhat more likely to have higher emotional engagement scores, or to be more emotionally engaged in the club. There is one outlier, a former member with the highest overall emotional engagement score who confessed to hating the costume. She realized the importance of costumes for the children's sake, though. She explained it this way:

> Personally, I hated the clown costume. However, the cosutmes peaked the interest of the younger students and gave the Whiz Kids the impression of being approachable and fun. As a result, the science demonstrations that we were presenting could also been seen as fun and accessable. The costumes made it possible for the students to relate to the Whiz Kids and to become engaged in our presenations. If the the younger students didn't have a reason to relate to the Whiz kids, we may have appeared to be intimatating and distant to the younger students. As a result, our presenatations would not have had the same impact of making science fun and accessable to the younger students. (7)

There is a moderate, significant correlation ($r = 0.416$, $\rho = 0.000$) between wearing costumes for attention-getting and cognitive engagement. Those who equated costumes with getting children's attention were somewhat more likely to be more cognitively engaged in the club. There are no outliers in the data to refute this finding. As shown in Table 11, the best-liked part of the club may not have been wearing the costumes, but it was certainly the most memorable. Three-year members still lead the groups with the most comments about memorable moments as wearing costumes followed closely by private school members, then females and non-Caucasians, and with male members offering the fewest comments about wearing costumes.

Wearing costumes also shows a moderate, significant correlation ($r = 0.470$, $\rho = 0.000$) to overall ECA engagement as well. Those who enjoyed and got attention by wearing costumes were somewhat more likely to be overall more actively engaged in the club. One outlier is a member who supported the finding by this comment: "Loved my awesome costume! - wouldnt have done it without costume. I am introverted - costume allowed me to perform." (57) The other outlier is the member (7) with the highest emotional engagement score who hated the costume but felt it was important for engaging the children. Thus, the data still tend to support the finding.

Former members generally expressed enjoyment in wearing costumes:

- I don't really remember anything that happened in particular at one of the schools, but I do remember wearing this really short skirt that showed my really skinny legs. (66)
- It was important to me at the time to pick my own character and be supported in my choice. This became more important when the children we worked with responded well to our characters. (79)
- No way, the costumes were the best. I still laugh at the thought of me as a butterfly. (27)
- It was also fun dressing up on a non-Halloween day. (16)

Former Whiz Kids reflected on the attention they got from their young audiences:

- I think the costumes really helped. Who does not like seeing liquid nitrogen etc. Those experiements were cool so it would be hard to loose kids attention. (86)
- Any child that sees a costume is likely to at least pay attention. (87)

- The costumes are a great idea! I mean, really truly creative genius in my opinion. I think we all enjoyed dressing up and I think the impact on our audiences was stronger. (14)
- It [wearing costumes] made the whole experience that much better. Both the volunteers and kids were more keen to participate and learn. (73)
- [Costumes] made it more enjoyable and light hearted. (43)

Not everyone was as excited about wearing the costumes and one offered this reason: “I didn't really care for the costumes as it added more prep time to the process.” (55)

School Spirit and Getting Out of School. Another component of emotional engagement is school spirit, an important precept of ECA (Dewey, 1916; Dunkelberger, 1935). To some, perfect attendance or engagement in classrooms may indicate more ties to the school. In science, some contend that simply increasing student participation in science fair projects of their own interests will increase student engagement in the science classroom (Wilson, Cordry & Uline, 2004) while others argue that good classroom experiences, rather than any outside school activities, attract more students to physics (Reid & Skryabina, 2002). Even though adult perceptions may not accurately represent the feelings and perceptions the individuals had as adolescents and their hindsight may tend to erase some memories, former Whiz Kids were asked about getting days out of school for club performances.

Although 30 (33%) respondents suggested that a day away from school has definite appeal, sounding like the working students who are more likely to cut classes (Zierold, Garman & Anderson, 2005), there is one important difference. When asked to respond to a comment that members joined the club just as a way to get out of school, every former Whiz Kids answered this question on the survey and were adamant that a day off school entailed more work and greater learning than a day spent sitting in a classroom. In fact, 91 (99%) respondents concurred on this point and one (1%) respondent said that they cannot remember.

An analysis of all their responses showed no correlation between belonging to the club to get out of school and any component of engagement; behavioral, cognitive or emotional. As shown in Table 11, the majority of the student disagreed with the idea of joining just to get out of school with few differences between groups monitored, with the exception of schools attended. More public school students reported that they liked the idea of getting out of school even though they had to do the class work they had missed, while private school students reported that having to make up the work they missed was the reason they did not want to get out of school.

There is a moderate, significant correlation between emotional engagement and school ties ($r = 0.450$, $\rho = 0.000$). Former members who expressed more connections with their school were somewhat more likely to be members who were more emotionally engaged in SSWK. There are two outliers in the data, representing two female members of the club. The first member tends to confirm the finding. This is the former Whiz Kid (7) with an overall emotional engagement score that is 133% higher than anyone else's score who was a strong supporter of the club as well as her school with all her other school ECA and sports. The second member tends more toward the idea that girls are less attached to their high schools but are closer to their teachers (Crosnoe, Johnson & Elder, 2004); school attachment and extracurricular participation decrease with age while student-teacher bonding increases with age. This very engaged, three-year member describes her connections this way:

> I had a lot of fun. I met some great people who were just as interested in their learning skills as I was. In the long run it was great to be around

> other high school students who had goals of attending college and persuing viable careers. I also enjoyed the great mentorship of Mrs. Kralina as she was more than a teacher or club leader, but made the attempt to have a relationship with her students and be a positive influence in their lives. (23)

Overall, the data tend to support the finding.

Former Whiz Kids made 131 (11% of all emotional engagement comments) responses regarding school ties and getting out of school. Their initial responses showing the appeal of a 'day off' sounded like this:

- If I'm being honest, initially the thought of getting out of school for a few hours was pretty enticing. (62)
- I love getting out of school! (83)

While describing his participation, one respondent also spoke of his responsibility to school, saying he would have preferred to NOT miss classes:

> The fact that we were "just getting out of class for a day" usually made life more difficult in the classes that we had to miss that day. In addition to doing the homework for the next day, you would have to find notes from the classes you missed and play catch-up for a few days. Ideally, I would have preferred that Suzy Science perform on the weekend so that we DIDN'T have to miss class, but that wouldn't work as we traveled to schools to perform. In theory, would some students just join a club so that they could miss school? Potentially. Would most kids at {my school} join the club so that they could miss class, knowing how difficult it is to catch up on missed classes and how their other teachers expected/required them to learn the material covered in class for the test or paper that was due at some point in the future? I highly doubt it. (22)

Their genuine school spirit and ties to school and learning are evident in their thoughtful responses as they elaborated more on what a 'day off' (days for elementary school visits) really meant for SSWK. First of all, 12 (13%) explained that it meant more work, making up their class work and on their own time:

- That is poor logic. It was harder to participate in the club than to simply attend a class. I still had to do the homework or take a test as if I had been in class, but now I had to do it on my own time so missing a day to perform the demonstrations meant additional work for me. (41)

- True you do miss school that day, but I used to miss more days playing golf, track, cross country, and acting in dramas. I would say missing school was just as tough, because you were expected to make up the missed work as you had been there. (49)
- We did get out of class which helped my (now diagnosed) ADD and gave us a breather from regular routine but that was just a side effect (and bonus) but definitely not the point of joining. (70)

The time and effort to prepare and perform on their 'days off' was also hard work as pointed out by 21 (23%) respondents:

- For some yes, but for me I enjoyed seeing a child smile when they learned something new. By the end of the day I was beat because it is hard work getting all your experiment and equipment together. (42)
- We were teaching children all day, which I hardly think qualifies as blowing off school (I did that enough without the club!). (11)
- High school students who don't want to be in class will be absent, either physically or mentally. Participating in an activity that requires physical presence and personal involvement would be a much more tedious way to skip class than to just sit and daydream. (65)

By an overwhelming majority, 62 (67%) respondents recognized the value of taking science outside of the school box and spoke of the value of their participation to them personally:

- The best thing was being able to do interesting science outside of the established curriculum. (91)
- NO WAY! It [SSWK] makes teachers It makes connections for the elementary school kids and high school kids. (69)
- It was more fun than class but I still learned something during the process and I felt I was getting kids into science. (50)
- Most definitely, we loved every minute of getting out of high school for the day and what a wonderful learning experience it was. We probably learned more that day that we were out of school - having to teach others - than many days we were in the school building. (3)
- It was so much fun performing the experiments and visiting with the children. It helped me to realize that I wanted to become a teacher, too. (15)
- I believe the performances not only increased the elementary students' curiosity in science, but also our knowledge of science, not to mention personal skills in working with others and children. (4)

Former members offered these additional insights in their unwavering responses:

- Many of the most important lessons of high school had nothing to do with the information presented in classes. I remember how reluctant our school was to let us out of even a few minutes of classroom time. Even then I thought it was misguided. I don't remember much of the actual data. I do still love to read about new subjects and explore the hills near where I live. (78)
- We are talking about students who have no trouble keeping up in their classes. Regardless of the student's motive, teaching and leadership experience can be considerably more valuable than a couple of hours of class time. It is great for a student to experience the responsibility of having something prepared well--or falling flat in front of an audience. Any thought one might have that it would be easier than sitting in class would be a mistake. It seems very appropriate to me that there be a perceived "reward" of leaving class in return for the students work to prepare and for the educational experience the student receives. (26)
- Not true at all, especially for the upperclassmen concentrating on getting into college. We still had to keep up with our work and sometimes missing important lectures for these field trips. But it was worth it because the elementary school kids were so appreciative and it was great to see them engaged. (33)
- While some students may always look for ways to escape their own class, the experience of the elementary school visits, the interaction w/ the children, etc. are by far more valuable than a couple of hours in the classroom. Life is not a classroom. As I recall, many Whiz Kid activities were on the weekends, and we all participated equally and happily in those as well. (40)

Working with Peers. Emotional engagement involves emotional responses to various aspects of ECA participation, but also involves those responses due to the influences and interactions with people. These significant persons include peers, parents and teachers. Whiz Kids offered these poignant reflections about working with their peers in the club, indicating that they enjoyed how well everyone got along with everyone else and supported each other, reiterating some of the sentiments in the earlier behavioral engagement remarks:

- We cooperated so well that we became friends. (32)

- My squad was great! We seemed to make our presentations flow together. (35)
- I recall assisting one another with demonstrations and pumping one another up if a demo didn't go so well. (61)
- We all liked each other and respected each other. (3)
- We were all friends, everyone was very welcoming and kind to each other. (84)
- We all clapped and cheered each other on. (85)

Former members offered these details:

- We played nicely together, and I miss that. I loved going to the schools and making my presentation better each time I did it. My peers helped me learn to talk in public without worrying that I might make a mistake. . . .We worked well together, teaching each other our tricks and giving each other ideas on things to try to make our presentation more interactive and fun for the kids. (45)
- I remember getting to know other club members more during our lunch on field trips and during meetings. There were different studnets, athletes, band members, thespians, scholars, we were somewhat eclectic, but all enjoyed working together. (21)

Three (3%) responses revealed some differences of opinions at times:

- Sometimes we squabbled...but it was never big. (45)
- For some reason I recall some in-fighting now and then, but I think in general we worked well together; I tended to avoid conflict so I don't recall details. (55)
- One person tried to take over but the rest worked well together. (72)

It is interesting to note that while many Whiz Kids cited joining the club because their friends joined or because their friends wanted them to join, they made more references to the new friends they made or just the club members in general rather than making specific mention of the particular friends who influenced their decision to join. These references were coded and showed a ratio of approximately 1:2 of friends to new friends or club members. There were 51 comments (4 % of all emotional engagement comments) about friends versus 111 responses (9% of all emotional engagement comments) about new friends or club members. The survey responses show a moderate, significant correlation between emotional engagement and working with new peers ($r = 0.585$, $\rho = 0.000$). Former members who enjoyed working with their new friends or peers were somewhat more likely to be members who were more emotionally engaged in SSWK. The lone outlier supports this finding as well, being the member (7) with the highest emotional engagement score and one of the highest new peers (EEN) scores. The lantern illuminates as readers recall that squads were formulated to promote equity as they read these comments by former members on making new friends:

- We got better as we became more comfortable w/ each other and our presentations. (72)
- The interaction with friends and some people that I might not hang out with on a regular basis. And the fact that we were teaching basic science concepts to all sorts of people. (46)
- I wanted to be around fun people, everyone in the club was a fun person. (45)
- A lot of my close friends were in the club and I made more friends through the club. (84)
- A few of my friends were in the club and I got to know better some other people that I may have met in passing or had a class with. (92)

For some, it was a learning experience on how to work together:

- It was learning experience all-around. The club was new. So, we were learning about the program as well as how to work together. An open mind and line of communication across all team members worked really well. (37)
- I believe the performances not only increased the elementary students' curiosity in science, but also our knowledge of science, not to mention personal skills in working with others and children. (4)

Some mentioned that they enjoyed the range of grade levels represented in the club:

- I liked best being able to socialize with students from all grade levels.
- It was a very social club where it didn't matter if you were a freshman or a senior, you all got along. (81)
- There were kids from all 4 grade levels in one group, which gave us the opportunity to teach & learn from each other. (67)

Using the coding schema, responses were categorized based on comments referring to their friends and comments remarking on how well members worked together. Results show that there is no correlation between friends and working together ($r = 0.051$). Nor is there any correlation between friends and engagement, not behavioral, cognitive or emotional ($r = 0.124$, $r = 0.128$, $r = 0.201$, respectively). This means that those members who mentioned joining and being with friends in the club are not necessarily those who were more actively engaged in the club. That is not to say that friends are not important, but that once they joined the club, members perceived that they made more friends, perhaps based more on common interests, increasing their circle of friends. The whole club became a club of their friends. Table 11 shows higher percentages of responses for new friends versus initial friends (the ones with whom they joined the club), particularly for the students at the large high school, especially females and non-Caucasians and one-year members. Whiz Kids commented that being with their friends was part of their most memorable moments in the club, but generally made fewer comments about being with friends as what they liked best about the club.

There were five notable exceptions; i.e., non-Caucasians never commented on friends, but ranked one of the highest in comments about their new friends. Since non-Caucasians were a very small minority at each school, the opportunity to meet new people and make new friends was perhaps more important to these teenagers. Being in a large high school of over 2300 students, public school students may have also appreciated the opportunity to meet new people and make new friends in a more relaxed club setting than in a classroom. The impact of friends seem less striking for the private school members who for the most part, had grown up in the same small school with the same students nearly every year of their entire lives. One-year and three-year members never made comments about being with their friends as what they liked best about the club. However, three-year members were the highest ranking about their new friends as what they liked best about the club. One astute Whiz Kid offered this insight between working with friends and working with new friends: "I think we worked very well together. There were 5 of us and 4 of us were close friends and they [that] may have hindered the 5 of us working as a cohesive unit on a consistent basis." (4)

Influence of Parents. Emotional engagement deals with significant others and besides the impact of peers, the influences and interactions with parents contribute to a person's emotional engagement in ECA. The specific impact of parents on emotional engagement ranges from selection and support to value-added appraisals of ECA. The parental influences for ECA participation (Baker & Leary, 2003; Eylon, et al, 1985; Olszewski-Kubilius & Seon-Young, 2004) are evident in SSWK. There does not seem to be any correlation between perceived parental support and student levels of behavioral engagement (Schneider & Younger, 1996) ($r = 0.025$) or cognitive engagement ($r = 0.075$) and only a weak correlation with emotional engagement ($r = 0.366$, $\rho = 0.000$), meaning that members who perceived their parents as being more supportive might have had a higher emotional engagement score. There is only one outlier to this finding, the member (7) with the highest emotional engagement score and highest parental support score, who also tends to support this finding.

Analysis shows weak negative correlations of perceived parental support and student self-ratings of intellectual curiosity and inquisitiveness ($r = -0.392$, $\rho = 0.000$), and for student self-ratings of creativity and imagination ($r = -0.205$, $\rho = 0.049$), meaning that with perceptions of increasing parental support/control, members might likely be those who self-rated themselves lower in intellectual curiosity, inquisitiveness, creativity and imagination (Fisher, 2005). The first correlation generates one outlier data point that tends to refute this pattern. The outlier represents several members with high parental support and high intellectual curiosity and inquisitiveness in a ratio of 2:1 females to males (similar to club composition) and 2:1 private to public (contrary to club composition). There are no outliers in the data points to refute the second correlation on parent support with creativity and imagination.

Every respondent answered the question regarding their parents' interest, although 6 (7%) could not remember. Their comments represent a complete range of parental interest and support. According to those who did remember, 72 (84%) respondents indicated that their parents expressed interest in the club, while 14 (16%) indicated their parents had minimal to no interest in their participation. Seven (8%) former members further indicated that they did not tell their parents about their participation. Parents expressing definite or strong interest in this particular club were mentioned by 54 (62%) respondents. As shown in Table 11, parental interest appears consistent, with lower percentages for male and non-Caucasian members, similar to other findings that families more closely monitor their daughters' activities than their sons' activities while contradicting the finding that parents of minority students have higher expectations for their children (Hossler & Stage, 1992). The most surprising is the highest parent rating was given to parents of one-year members. One-year members, primarily seniors, were trying a new ECA in their senior year and rated their parents as very interested in their activities. This might be indicative of students receiving support to try new things, or may be indicative of parents manipulating activities to build resumes (Guest & Schneider, 2003; Swanson, 2002). The highest parent interest ratings were also given to parents of members at the private school, followed closely by parents of female members and Caucasian members.

As stated earlier, no one cited their parents as the reason they joined the club and no one responded that way on this question either. Parents were not present at club meetings or practices, nor did they impact the selection of demonstrations or topics. Parents served as lunch monitors and brought lunches from fast-food places near the elementary schools. These teenagers giggled about having 'room moms' again (they had not had them since grade school) but they loved having 'lunch out', away from the high schools (room moms carried it into the schools for them). Supporting findings that girls need at least low levels of support from their paternal figures in order to positively impact their level of hope for the future (Davis-Maye, 2004), nine females made references to their fathers' attitudes and involvement as opposed to only two males who made references to their fathers. Responses regarding parents seem to fit into one of four groups – did not know, too busy, supportive but not active, and active club supporters.

In the first group, seven respondents (8%) said their parents did not know or were not told about the student's involvement in the club. Whiz Kids stated several variations of their parents' lack of knowledge:

- My parents were fairly unaware of what I did in high school beyond theater performances that they were invited to. (2)
- I think they would have been supportive, but I was fairly independent in HS and I don't think they knew I was in the club. (55)
- My parents were not aware of my involvement with Suzy Science. (52)

The second group included fourteen respondents (16%) who indicated their parents seemed disinterested, perhaps too busy or complacent about their child's participation in the club. Whiz Kids made these comments regarding their parents' minimal involvement:

- My parents had four kids and both of them worked. They were neutral, and probably glad that it was the Science club, because how much trouble could the Science club kids get into. (45)
- They didn't say either way. (42)
- They were for it, but they needed me to balance the rest of school with theater. (71)
- They were happy that i was involved in a science related extracurricular, but not very interested. (65)
- They didn't say much about that type of stuff. With 5 children in the house, I think they were happy to make it to as many of our events as they could. Not a lot of discussions otherwise. (56)

In the third group and for the most part, 72 respondents (74%) felt their parents were supportive of the club, with 18 respondents (21%) rating their parents as being supportive, although not actively. Most listed 'my parents' while some just named 'mom' or 'dad' in their responses. There are no data to indicate family status for these respondents but none of the former members were barred from participating in the study because of parent marital status (Jodl, Michael, Malanchuk, Eccles & Sameroff, 2001). Former Whiz Kids commented on their parents' support this way:

- Of course my parents were thrilled I was in such a fun science club! (14)
- They [my parents] appeared to enjoy that I was spending my time doing something academically involved, in addition to sports and friends. (16)
- They [my parents] were happy that I found something I enjoyed that was academically related. (34)
- My parents tried to be very supported. I think my dad would have liked to have been more involved because chemistry is his background but like most parents he was too busy. (35)
- I think they [my parents] were proud that I was so involved in Suzy Science. They also liked that I recruited my sister and her friends from

the classes below and that it became a "cool" thing to do because of all the people involved. (36)

- My father, a math teacher, was glad I was taking part in science (all three of his children are artists). My mother was glad I was making friends and a teacher liked me. (70)
- My dad has also brought up the club or its teacher throughout the years. He thought it was a great experience and that the teacher was extremely talented. (3)

The fourth group was comprised of fifty-four respondents (58%), who felt their parents were active supporters of the club. Many of them stepped forward to help with costumes, or to serve as practice audiences, chauffeurs, room moms, photographers, door guards, lunch patrol, and cookie queens. Former Whiz Kids recalled their parents' active participation in these comments. Parents made costumes:

- My parents were glad to see me involved in things I enjoyed. My mom helped me with costuming. (26)
- My parents supported my participation in academically related activities. My mother made and maintainted my costume. (60)
- My parents were very supportive esp since it was a science club and that I had to speak in front of people which was very hard for me when I was in highschool. So they thought it was good for me and encouraged me to do it. My grandmother even helped me make a costume. (83)

Parents came to events and helped Whiz Kids practice their presentations:

- They [my parents] came to several events and thought they [the events] were wonderful. (88)
- My parents were very supportive of my involvement in the club. They would always ask me how things went after a demonstration. They were typically my audience when I practiced my lines and experiment. (80)
- My parents thought the club was great. They came out and took pictures when were marching in the homecoming parade. We were all dressed up running around, arm in arm. (21)

Emotional engagement responses regarding critical parenting can be negative, indicating student stress (Koutsoulis & Campbell, 2001), but none of the SSWK members illustrated that type of stress. However, students in the club did make references to pressures from home to do well in school and to get good grades. Comments from former Whiz Kids stated that parents would pull them from the club if they did not keep up their grades because they were gone from school for club performances. Former Whiz Kid elaborated on parental intervention this way regarding their school work:

- I will admit that getting out of classes for the day was pretty cool at the time. Despite having to make up all the missed work. I don't know about everyone else's parents but if my grades suffered I would not be missing classes. My parents were supportive but they could also see that I cared enough about being in the club that I'd get my assignments done. (80)
- They [my parents] were very supportive and didn't mind that participating in the club meant missing some classes. I had good grades. (24)

Pressure to achieve does exert stress on adolescents while ECA participation offers opportunities to relax and unwind from such pressures in an accepting, non-threatening environment. These female former members recanted these feelings of relief:

- It was a fun educational release during an often stressful week. (50)
- I think it [SSWK] was fine the way it was. Not too much stress or unrealistic time commitment. (14)
- This was a fun release for me, where I could be outgoing and have fun but was not a major draw on my time. (64)
- It [training] was a joint effort between Mrs. Kralina and the other students. It was definately a cohesive environment and allowed each student to learn by observation and then to put those skills in place. If ever a character needed assistance, others were good about helping out but not taking over. (30)

One male former Whiz Kid described the atmosphere within the training period:

> A new student would receive: - guidance on what character would best fit their personallity, experiment, and needs of the overall group. - guidance on how to complete, explain, and answer questions surrounding their experiment. - practice runs on their experiment and the group presentation overall. - assistance with character costumes. - an informal & low-pressure environment. (80)

These students felt a relaxed, low-pressure club atmosphere was important:

- I joined the club to have fun with my friends and teach science concepts to younger students in a fun environment. I was able to achieve all of these things and didn't feel that the club was too much of a burden when it came to time commitment. . . .Overall, I would like to stress that it was NOT viewed by club members as a way to 'get out of class' It was a good way for people to develop their public speaking skills in a non-threatening environment. And, of course, the costumes always drew laughs from those who usually saw you in normal clothes, and a little laughter in life is always a good thing. (22)
- A warm welcome from Mrs. Kralina, and other participants, followed by an enthusiasm/curiosity/willingness to know more or to become involved in the world of science. Next, discussions of science interests, previous experience/knowledge, an opportunity to observe, and try a variety of science related activities, and ask questions in a relaxed/fun environment. (76)

Emotional engagement and the opportunities to relax with friends in a secure environment become even more critical with changes in family situations, changes that are frequently included in risk factor studies (Everson & Millsap, 2004; Mahoney & Stattin, 2000; Marsh & Kleitman, 2002; McNeal, 1995, 1998; Reis, Colbert & Hebert, 2005). Survey responses indicated an overwhelming agreement (96%) that participation in SSWK definitely satisfied student needs and expectations, although only a weak correlation ($r = 0.335$, $\rho = 0.001$) existed between meeting needs and emotional engagement. Stated another way, former members who had higher emotional engagement scores were likely be those members who perceived that SSWK had better met their needs and expectations while they were in high school. There are four outliers that represent four former members who left the question blank, so it is left to the readers to draw their own conclusions from their silence. As shown in Table 11, members uniformly indicated that the club met their needs and expectations very well, with a slight variation for members at the private school. This might be expected due to the range of

ECA and required after-school sports also available to students at that location.

Meeting student needs and expectations means sensitivity to risk factors that apply to all socioeconomic levels. Whiz Kids told of personal pain and family tragedies; how an ECA [SSWK] offered them respite and a welcome shelter in times of hardships. Sensitivity to these risk factors allows educators to meet students where they are and help them through difficult times. Parental neglect was not listed by Reis, Colbert, and Hebert (2005), but Davis-Maye (2004) reports that absent fathers also impact student participation and learning. While these memories are many years old, some of the pain due to changes in family structure can still be heard resounding in these memories. Some painful incidences percolated to the surface while answering general questions, while others were responses to the question, “How would you describe your parents’ attitude about your participation in the club? What did your parents think or say about your participation in the club?” Here is what they said:

- I was involved my senior year with Suzy Science and the Whiz Kids as Raggedy Ann and did the tuning fork/sound waves experiment. I was at all events except one after my grandfather died that February. (10, graduated 22 years ago)
- Because this impacts my answers as well as my involvement in the club I would like to state that during this year in high school my father died. I suspect that my involvement would have been on going if it were not for the obvious turmoil in my home life. (27, graduated 21 years ago)
- I don't recall them [my parents] ever saying anything about it. (18, graduated 18 years ago)
- I'm not sure they [my parents] ever took an interest in what the club actually did. (23, graduated 21 years ago)
- I am not sure my Mom even knew what it was all about- she never asked and I really didn't think it was something she was interested in. (30, graduated 15 years ago)
- My parents were not involved in my life past grade school, but they did support me. My dad worked a lot and my mom was an alcoholic so I didn't interact with them much. (5, graduated 22 years ago)

One former Whiz Kid shared this story of how a simple invitation to join a club at the strategic time in her life made a lasting impression:

> Completely unrelated to science, Mrs. Kralina was an empathetic teacher that cared about her students in ways that were greater than anything we could learn in school. She had a profound affect on my life after a close friend's father died and I always appreciated the time she took to help me. Later in the year she reached out to ask if I would join the club (I didn't understand why since science was never my favorite/best subject) and I agreed because I knew she was a kind soul and wouldn't have asked if she didn't think I could do it well. Basically, I joined simply because I trusted her and she asked. (16, graduated 17 years ago)

Influence of Teachers. The last group of significant others in addition to peers and parents that impacts emotional engagement is teachers and the student's reactions and responses to them. These are the comments about the interactions the Whiz Kids had with their teacher/sponsor (me):

- Mrs. Kralina was(is) a person I admired because she was super-intelligent, skilled at what she did, and seemed to enjoy life. 1. I wanted the opportunity to be around a person like that 2. She helped us feel that we were competent and valued. (26)
- The teacher (club advisor) was the teacher that had the greatest impact on me, she still is what I reference in my head when I look for effective teaching practices. (63)
- Mrs. Kralina was great! She brought enthusiasm to the high school student which was contagious all the way to the elementary kids and teachers. I believe this was a highlight of my school years and remember it fondly. (25)
- Thank you to Mrs. Kralina for her excitement for science. She was one of the best teachers I had and her teaching style made me really interested in pursuing science. I am so grateful that she sponsered this club and that I had the opportunatey to participate. (28)
- My most memorable experiences are memories of our wonderful teacher Mrs. Kralina and showing us how exciting science can be so we could teach others. And I enjoyed my costume as well as other costumes! I'm not sure if Mrs. Kralina thought of this idea [SSWK], but if she did, she is a genius and should go around teaching about the group nationwide. (3)
- The enthusiasm and the positive attitude from the teacher is a must and really helped energize us. I think that was a factor in making this club successful! (86)

Another responded:

> I just remember maybe the first time I put on the Matador costume and feeling ridiculous! A couple of the other students were giving me a hard time. But Mrs. Kralina kept saying "You look great! Get over it!!" hehe *[I don't remember saying this!]* I eventually got used to it. For a while I did a demonstration that involved putting a marshmallow in a vacuum chamber and it blew up really big. The kids really liked it. But the marshmallow tasted horrible afterwards. (49)

Emotional engagement involves the teachers' high academic expectations for students involved in ECA (Black, 2004; Jussim & Eccles, 1992; Rehberg & Schaefer, 1973; Van Matre, Valentine & Cooper, 2000). Former Whiz Kids document their perceptions of the strategies used in the club that got them emotionally engaged in learning (Bidwell, Frank & Quiroz, 1997). These strategies include, but are not limited to outlets for educational/scientific interests, challenges, purposeful activities, project ownership, and learning from mistakes. Whiz Kids described the strategies this way:

- I was encouraged to challange things that I disagreed with. I learned that it was acceptable to disagree and object to things that I did not agree with, as long as it was done in a polite, intelligent fashion. I learned that it was acceptable to have a dissenting opinion, as long as that opinion was well thought out. (64)
- Mrs. Kralina, she was a good mentor, she never came down on you because of what you did or did not know. I remember feeling comfortable talking to her. What ever your situation may have been, she always inspired you to know/to want to know/be able to do more. (76)

One former member expounded on this topic at some length:

> I think the purpose of the club was to allow the high school students to be able to have a way to express themselves, to take what they loved in science, and share it with the kids that were coming up behind them. They could share with the grade school kids. It combined, it was a brilliant way to combine what appeared on the surface to be a social activity, but then to drive home the knowledge behind the science and then teach the high school people how to present in a way that folks could understand. I'm probably not explaining that very well.
> *[You're doing fine. Go ahead.]*

> You don't really learn something until you have to teach it. I think that's one of the clearest thing I've learned throughout my life. There have been a couple of times that people have given me things to teach that I knew nothing about. My God, I can't do this. But that's when you really learn it. I think you helped us do that, without knowing that you were doing that. I don't know if that was the goal, but that is what came across.
>
> Now I need to understand this, because the first time you were out there and Little Johnny Smartypants comes up with "What about the 'what whose it' with the whatever?" and he is asking helium is an inert gas and hydrogen is not an inert gas and what is the difference between that. And if that is something that you've got to teach and you don't know, you never forget that again.
>
> So I think that was kind of the purpose. It taught us science, but it taught us in a way that we didn't know how well we were learning it. Then it taught us how to present it to others. From the grade school student's standpoint, it was just a fun way for them to be able to learn. I think they paid more attention to us because we were in colorful costumes and jumping around and were obviously enjoying, doing what we thought at the time was more of a social activity. (I-6)

Several Whiz Kids discussed the level of ownership they felt that they were given in developing their demonstrations. Their perceptions are the reality of what they did:

- The typical preparation for myself was doing research on the experiment and coming up with a 10-15 minute presentation for it. You could do as much or as little as you wanted to do, but it needed to keep the kids attention for that long so they were not bored. (68)
- I know we met as a group and had attendance and thank you note expectations explained. I beleive we worked on developing teams and discussing things we would like to do as a squad. I am not sure how much was predetermined, I believe we did a lot of it ourselves. (21)

One former Whiz Kid gained insight into the value of making mistakes. He explained:

> Goofy stuff is what kids remember. It's a release for them from the regular day-to-day classroom stuff and that is what was fun about Suzy Science. We used to go in, goof it up, and we'd make mistakes, but we'd fix them. We'd do other things. We took turns, doing different experiments.
>
> *[How would you know that you had goofed it up?]*
>
> You'd do it and hey, that's not right! Then you'd realize that that was not supposed to have happened. You'd made a mistake somehow. Sometimes, you let them know because it's like, hey, anybody can make mistakes. The best part is realizing you did it and saying, "Let's re-try

> that."
>
> We'd do the 'lean over at the waist, put your forehead against the wall, and try to pick up the trashcan' trick. Well, if it was the Rubbermaid trashcan, there was no challenge to it. Anyone could stand up! But if it were the older metal trashcans, the guys couldn't stand up. You had to have a *weighted* trashcan. So one of the times, we tried it and both the guys in the class stood up. We'd say, "Hey, something is going on here. We are not supposed to be able to stand up." And we looked around and realized that the trashcan had no real weight to it. So we had to find something else and explained the whole concept behind it. Sometimes, with the mistakes, you can teach them *more* about it than if everything went right. If everything went right, they don't always remember, but if you made a mistake, boy, do they remember that! (I- 11)

Former Whiz Kids also affirm that they like adults whom they perceive as responsive, but not over-directive and who provide them with structure, challenge, and support (Dworkin, Larson & Hansen, 2003; Van Petegem, Aelterman, Roesseel & Creemers, 2007). Coding results indicate a high frequency 380 comments (42% of all behavioral engagement responses) regarding the structure and routines of SSWK. Their comments included these:

- I remember how well organized our club was. This was key to good communication and collaboration among the club members. (62)
- The club was well organized and informative, but most of all fun, which is what was rewarding when it came to the kids. (39)
- I really enjoyed dressing up and working with children. The events were well planned out by Mrs. Kralina. (59)
- [The things I liked best about the club were] Energetic group of members Fun activities and costumes Interaction with kids Fantastic leadership (organized, enthusiasm). (13)
- I don't recall wanting to be a memeber, I think Mrs. Kralina just recruited me. (18)
- Mrs. Kralina made science exciting. She was always willing to help, always available, and she really wanted her students to undersstand that science was relevant in everyday life. (34)
- While my (and my wife's) experience in the club was over 20 years ago, we both still have fond memories and enjoying keeping in touch with Mrs. Kralina. I would interested in seeing programs like this in my kids' schools to help their interest in science, physics, and engineering. (61)

One respondent's comment gave this affirmation:

> As mentioned before I had a lot of fun. I met some great people who were just as interested in their learning skills as I was. In the long run it was great to be around other high school students who had goals of attending college and persuing viable careers. I also enjoyed the great mentorship of Mrs. Kralina as she was more than a teacher or club leader, but made the attempt to have a relationship with her students and be a positive influence in their lives. (23)

One respondent offered this appreciation for the elementary school teachers he met during club visits:

> There were some schools where we were treated better than others by the faculty that was there, but I don't remember which one. They were very thankful and very welcoming of us when we would go there. Some of them, we would have a Subway sandwich, the long one, brought in for us. Teachers would come in there, being very nice and talking to us, thanking us for coming in and showing their kids that science could be fun. That was the other thing. You got thanked by teachers, which is not always a common thing when you're a student. (I-11)

Female Whiz Kids indicated an increasing attachment to their teacher in these remarks (Crosnoe, Johnson & Elder, 2004):

- None the less she was the instructor I wanted to someday emulate. She never gave up on me no matter how much I struggled! I wanted to help her get the club going. (5)
- I enjoyed the group, the leader, hanging out and doing experiments. I loved the school visits seeing the students have fun and getting letters. I remember and still have the notes from students and you [happygrams sent after a performance]. You would send us the school fundraiser telegrams [notes sent to individuals with compliments on their recent performances] and I still have those. (21)
- Mrs. Kralina made all the difference in my satisfaction. I remained in contact with her after high school because she had a significant positive impact on me. (34)
- I would like to thank Mrs. Kralina for devoting a great deal of her personal time to extend this opportunity to me during high-school. (7)

One response included this reflection:

> My time working with Mrs. Kralina is still a very cherished memory. She was always our teacher and became very much our friend as well. She

> worked so hard to make Suzy Science happen in order to get others excited about science. She was very inspiring to me personally. (11)

One of the foremost researchers on gender and science, Kahle (1983) describes characteristics of teachers who successfully encourage girls in science as offering organized, stimulating classes with a variety of instructional strategies (Hoffmann, 2002; Reid & Skryabina, 2002) and career information, being respected by students and parents, as well as stressing creativity, basic skills, and equity. Some of these same qualities were mentioned by former Whiz Kids regarding their experiences in this ECA:

- It [SSWK] allowed my to see more creative teaching styles and the simple tricks were excellent examples of 'cause and effect.' (6)
- My parents thought it was a great club to be involved in. (63)
- The leader was amazingly creative, energetic and smart! (13)
- I found it easier to understand and much more fun. It was a creative turn to the problems at hand and allowed for a much different perspective. . . .I would say that we had a lasting impact on those children. Some of those kids didn't understand science and again don't think like text book thinking- they needed a creative avenue for Science and this allowed them to try new things and get excited about education. (30)

Although teachers can serve as change agents (Hammrich, Richardson & Livingstone, 2000), the gender of the teacher/sponsor impacts student-teacher interactions (Klein, 2004; Stake & Granger, 1978). Some female SSWK members did describe the influence they perceived in their female sponsor this way:

> Another thing is you made us all feel special. That's why I'm sure you had a similar interview with {another member} because you made {another member} feel special. You made me feel special. I bet probably every student you meet in that school talked about how they felt special and that wasn't just your program. That was you! You made us all feel like we were special and we were great! We could do this and we could do it well and it was going to be fun. I just think it's so great for a high school student to feel that way!
>
> Being able to use my creative skills without being considered strange or different. It was okay and encouraged to be different and you could pass that on to the kids who were watching your experiments. I

> really enjoyed the variety of students who were involved from the program and learned something from each one of them.
>
> I remember a day when you gave me grace. I had forgotten something at home and I remember that it was absolutely not okay for people to forget things. But you gave me grace to bring it in the next day. So thank you for that. I still remember that because it was such a big deal for me. (I-7)

Many researchers urge teachers to increase the engagement of females in science by offering more small-group work and equitable, hands-on science activities to reinforce ideas (Campbell & Clewell, 1999; Hammrich, Richardson, & Livingston, 2000; Haussler & Hoffmann, 2002; Kahle & Meece, 1994; Murphy & Whitelegg, 2006; Reid & Skryabina, 2002; Stohr-Hunt, 1996; and Talbott, 1997). Former female Whiz Kids expressed similar desires:

- I also did science experiments in my own classroom similar to the ones we performed in the club. I realized the importance of getting the students' attention and providing hands-on learning through my experiences in the club. (15)
- Interactive, hands-on experiments will always stay with me (versus a textbook memorization may only last through an exam). (13)
- I enjoy science especially in home science experiments. I enjoyed doing something "cool" for others. The students we visited always seemed to enjoy it. I developed a greater enjoyment for science and would bring the items to conduct experiments at our family functions. My siblings and friends all enjoyed coming over and doing a new experiment. (21)
- It did increase my knowledge of science. It helped to me to understand some very difficult concepts by making it hands on. (81)

Emotional engagement of the Whiz Kids has been shown in their most memorable moments, interests and attitudes toward teaching and science, responses to the activities and costumes, and school spirit as well as their responses and interactions with peers, parents and teachers. Based on the strong evidence of emotional engagement, former Whiz Kids may also have experienced the benefits from emotional engagement, that is, increased interpersonal skills, social networks, positive attitudes and connectedness.

Emotional Engagement in SSWK: Benefits

Interpersonal Skills. One of the significant benefits for emotional engagement in ECA participation is the development of interpersonal skills and social networks. ECA improve school spirit (Dewey, 1916), champion non-academic skills (Wanlass, 2000), and fosters a richer social outlook in its participants (Dunkelberger, 1935). In addition to the skills described in previous comments, interpersonal skills and social networks were definitely enhanced through participation in SSWK, as attested by 162 comments (14% of all emotional engagement comments), such as these:

- It [SSWK] made my high school experience more enjoyable. Before that I just tended to avoid interacting with most people. (12)
- Since it was my one and only year at that school it helped me to develop new friendships. (18)
- I can remember how wonderful it was to have friends in other grades and that we all shared this fun connection. I still keep in touch with some of my club friends. (35)
- My relationships with other group members gave me a solid group of friends with common interests. Without that, I may have had a difficult time finding those kind of relationships. (34)
- I'm sure I was in the club with people I probably would not have associated with in any other club or group. (51)
- I liked that it was a group of students from different walks of life/groups. That alone made it fun and avoided the "clique" atmosphere. (16)
- SSWK was a great addition to my high school experience. I still tell my wife about doing it, and she gets tired of hearing about it. I was able to get to know a lot of other people that I didn't already know. (68)
- We weren’t friends before but we have been friends ever since. (I-7)

Sixteen (17%) former Whiz Kids frequently mentioned the importance of good communication skills in their perceived ability to work well with others:

- Helped in communication and presentation skills. (47)
- They were the type of kind-hearted student who enjoyed working with young children. Because the club brought together such students, we communicated and worked together well. (7)

- It was better than I expected as far as social communications went. I just wish that I had done more with it! I think I was only in the club for a few weeks before I graduated. (12)

One member described the importance of communication and cooperation this way:

> We worked together well. we had too or we would have had problems with timing, demonstrations not be continuous, being able to see when to start the next demo. All of these required communication to be effective. In the beginning it was difficult, because everyone was learning how work with each other, the experiments, and leading the demo. It got a lot easier, after practice ahead of time and after the first day at a school with live participants. (49)

Social Networks and Connectedness. The second benefit of emotional engagement is connectedness. Feelings of belonging and being connected to a group of peers, trusted adults, or a school are also a benefit of ECA participation, one that can help to build connections well past high school. According to respondents, 16 (18%) joined SSWK, giving social interactions and a desire to belong to the group as their reason. When asked what they liked best about the club, 39 (44%) responded that they felt they belonged, they liked feeling like they were a part of a group.

As shown in Table 11, race and longevity benefited the most from belonging. The group who benefited the most was the non-Caucasian members and not surprising, with each year, members felt increasingly more a part of the group. Female members benefited more from belonging than male members and public school members expressed greater belonging than private school members. These adult Whiz Kids recall their perceptions about belonging and its importance to them as adolescents:

- Mrs. Kralina made science fun and everyone belonged. . . .I belonged to a group and had a great time. I just wish I had joined earlier. (10)
- This group put me with other people that had the same interests as me and gave me a group to belong. That is so important in high school because it is such a time of change and growth. (28)

- I liked the idea of being a part of something that worked with kids in the community. (19)
- They want to belong to a group, and Suzy Science gives you that. That's one reason why I mentioned that I liked it. Because I felt a part of the group. (I-7)
- It [SSWK] was something that I enjoyed being a part of and looked forward to the different opportunities. (29)
- I grew up wanting to be a part of it. (68)
- I definitely felt that I was part of something larger than myself, as they say. (75)
- I feel that everyone that I knew in the club enjoyed working with others and being a part of the club. (38)

Positive Attitudes. In addition to the benefit of developing interpersonal skills and social networks, a third benefit of emotional engagement in ECA is that it promotes positive attitudes in members and fosters a tone of inclusion, giving students a vested interest in the affairs of their school, increasing their engagement, and building school spirit (Cushman, 2006; Darling, Caldwell & Smith, 2005). Positive attitudes and attributes were mentioned by 31 (34%) SSWK respondents. Former Whiz Kids expressed it this way:

- I think it let me be become part of a cohesive group who worked very well together. No cattiness, no arguing or whining- it was a very positive group. (30)
- I was terrified of taking chemistry. The club really put a positive spin on it and made me want to work harder in the class. (63)
- It had a positive effect, meeting new friends & having enjoyable experiences that improve my overall memories of high school. (67)

One respondent elaborated on this characteristic:

> I never remember anything negative about our squad or group. The club culture was positive and upbeat we were not worried or preoccupied with individual performances. We were more focused on doing or presenting for others. The focus was how are we going to demonstrate things and what we wanted students to know versus what we could tell studnets. (24)

Not only did respondents voice that all the members liked science, but one member noted in three separate responses that Whiz Kids were all kind-hearted:

> I have a very positive memory of the club. I joined the club because I liked science and liked working with younger studnets. I was happy to find that the club gave me a time to be with a group of studnets who shared my interst in science and were also the kind-hearted type of students who enjoy working with younger children. I appreciated that the club gave me the opportunity to meet and work with this group of people. Because the club brought together such students, we communicated and worked together well. (7)

Impact on Overall High School Experience. When these former members were asked about the impact on their overall high school experience, 89% of the respondents report their perception that participation in SSWK definitely and positively impacted their overall high school experience, or school spirit, with 29% indicating that it has made a significant positive impact. As shown in Table 11, the group experiencing the greatest impact was the three-year members. The longer they were a member, the greater the impact. The second highest rating was given by female members, several who commented on the inspiration it gave them to pursue their dreams and goals. Public school members showed a slightly higher rating over private school students in this area, indicating more satisfaction with their high school experience because of their participation in the club, while private school students indicated a satisfying high school experience that included SSWK. Male members and non-Caucasian members rated the impact on their high school experience somewhat lower than the other groups, although still satisfactory.

There is a moderate, significant correlation ($r = 0.456$, $\rho = 0.000$) of emotional engagement and impact on overall high school experience, showing that those who were more emotionally engaged in the club were somewhat more likely to feel that SSWK had more impact on their high school experience. With most scores tightly clustered and then seven outliers, there is definitely some other factor(s) in this correlation. Former Whiz

Kids described the impact of SSWK on their overall high school experience this way:

- It is certainly one of the activities that sticks out most when I think back upon my HS experience. (4)
- Great all around club. It was well run and I did not remember ever being bored. This experience was one of many experiences I remember from High School. It was fun and educational. I hope my son can get involved in a group like this when he is of age. (86)
- When I think back on high school, I think of football, wrestling, proms, dances, cars, music, friends, teachers, and chemistry club. (20)
- High school is spent, most of the time, on social issues and activities, this was based on education and expanding knowledge. (54)
- It really was a good experience, if too short for me. One of the highlights of a high school experience that was more often than not emotionally upsetting. Suzy Science along with theater really kept me going. (12)

Some responses were more lukewarm:

- Because I was not involved for a long period of time, I don't think that it had much impact overall on my high school experience. (27)
- I thought that the TEAMS and Science Olympiad competitions had more impact [on my high school experience] because they were more intellectually rigorous. (91)
- It did not impact me as much as my music participation, but I think it was another positive experience at {my school}. (60)
- My involvement in this club did not take up nearly as much time as my involvement in other extracurricular high school activities. It is most probable that my high school experience would have been very similar had I not participated in this club. (52)

Emotional Engagement in SSWK: A Summary

The third component of ECA engagement is emotional engagement. Emotional engagement in SSWK covers a wide range of interactions and influences on the lives of adolescents, ranging from favorite memories, interests and attitudes about academics, school, peers and the significant adults in their lives. The benefits of ECA emotional engagement are seen in the development of interpersonal and communication skills, social networks with peers, teachers and new friends, positive attitudes, and the connectedness and belonging both in and beyond high school.

SSWK members with higher emotional engagement scores were

1. very highly likely to exhibit higher overall ECA engagement scores;
2. somewhat more likely to indicate a greater interest in science;
3. somewhat more likely to enjoy working with children;
4. somewhat more likely to feel more successful in engaging students;
5. somewhat more likely to make more emotional responses in the survey;
6. somewhat more likely to enjoy wearing costumes;
7. somewhat more likely to express connections to their school;
8. somewhat more likely to enjoy working with new friends or peers;
9. somewhat more likely to feel SSWK had more impact on high school experience;
10. likely to have improved their attitude toward science;
11. likely to have described their most memorable moments on the survey; and
12. likely to be those who joined the club for reasons other than to get out of school.

Despite the major studies on gender in science ECA and emotional engagement, this study shows no correlation for gender effect (Kahle, Parker, Rennie & Riley, 1993) with respect to any variable tested, with no gender bias present in club participation, choice of experiments, or leadership. There may have been some previous gender differences at entry level based on assumptions about their responses, but comments from the respondents indicate that this difference, if any, soon dissipated with practice, repetition and increasing comfort levels regarding science concepts and equipment. Students identified specific club strategies that insured gender equity, particularly organization, challenge, and leadership opportunities.

The overwhelming responses given as to why they liked the club was because the members enjoyed teaching children (making a valued contribution) (51%), had a sense of belonging (44%), and because it was *fun* (38%). This *fun* took place in a carefully organized and structured ECA that still allowed room for creativity, challenge and skill mastery, an ECA scenario advocated by many researchers.

According to respondents' perceptions and memories, students of all age levels and abilities took part and got along with each other. Many members commented on the quality of the personal relationship that they felt they had with their teacher/sponsor. Many mentioned that they still have cards or notes sent to them by their sponsor 10-25 years ago. Considerable comments were made regarding parents, with four functional types identified. Respondents indicated that no member ever joined SSWK because their parents made them, contrary to some findings (Eylon, et al, 1985). Membership may have been initially considered for resume or investment building for college, but the overwhelming majority of the members remained with the club for its perceived fun and value in advancing science interest and working with children.

Emotional Engagement in SSWK: Regression Analysis

The coding schema was used to code survey responses based on the content and evidences in their statements and then tallied to give survey respondents a score for each variable of emotional engagement. Adding together all the scores for these variables

Table 12. Summary of All Emotional Engagement Responses

Coding	EEA	EEB	EEC	EEE	EEF	EEI	EEN	EEP	EES	EET	EEW
Variables	Activities	Belonging	Children	Emotional responses	Friends	Interests in science	New peers	Parents	School	Teacher	Wearing costumes
Total # of Responses	74	36	175	346	51	121	111	62	131	65	66
Percent of Responses	6	3	14	28	4	10	9	5	11	5	5

generated an overall emotional engagement (EE) score for each participant. The 1237 responses coded as emotional engagement (EE) constituted 46 % of all survey engagement responses. The final tally of all the emotional engagement variables is shown in Table 12.

In analyzing the responses from the former Whiz Kids, overall emotional engagement scores show the strongest correlation ($r = 0.843$, $\rho = 0.000$) of any engagement component with respondents' overall ECA engagement, with only one outlier (7) whose views were discussed previously. Using a multiple regression analysis for overall ECA engagement and emotional engagement as measured by activities, feelings of belonging, emotional responses, influence of friends, parents and teachers, meeting and working with new peers, interests in science and teaching young children, school ties and the impact of wearing costumes yields $F_{(11, 91)} = 29.106$, $\rho = .000$, reiterating a very strong correlation ($r = 0.843$). After correcting for interaction effects ($0_{adj} = 0.751$), this analysis shows that 71.6 % of the variance in overall ECA engagement can be explained by these eleven emotional engagement variables. Thus, this data tends to support the assertion that emotional engagement is an important component of ECA engagement (Fredricks, Blumenfeld & Paris, 2004).

Limitations to Engagement in SSWK

Some limitations of ECA engagement noted in previous studies are addressed in this study, specifically, subject matter remediation, selectivity, timing within the school year and costs for participation, and school size.

Subject Matter Remediation. Some studies lament that ECA are generally remedial in nature (Baker, Akiba, Le Tendre & Wiseman, 2001). Although 74 (80%)

former members perceived that their knowledge of science had increased because of their participation, some Whiz Kids indicated that they had not learned anything by being in the club because the science concepts were those covered in younger grade levels: "Not really. The concepts were very basic." (24) Others recognized that the concepts were intended for younger grades, but that they still learned the concepts or new application of the concepts. They explained what they learned:

- I also liked the education that I recieved while participating in the club. It made me realize that anything is learnable even theories and concepts that are complicated. (54)
- The club reenforced fundamental concepts learned in classes by giving them applications. A way in which to visualize the scientific phenomenon. (49)

Participant Selectivity and Safety. ECA participation and its benefits have been criticized as being limited due to selective criteria, such entry-level requirements or acceptance of adult values (McNeal, 1999; Morgan & Alwin, 1980; Ostro, 2006; Pipho, 1986). This criticism could be leveled at SSWK, which had two entry-level requirements, one imposed by the school requiring a minimum GPA and one imposed by the club sponsor of a chemistry course prerequisite. The latter restriction was strictly for safety reasons. This concern encompasses the safety not only of the presenters but also of all audience members. Requiring SSWK members to have taken or be currently enrolled in a chemistry course ensured that all participants had passed essential safety tests and that all members and their parents had signed safety contracts. The selectivity of this requirement did not prevent those who were hesitant in their science abilities from joining, as evidenced by the comments from members presented previously, but did insure a high level of safety and responsibility in conduct and in the overall environment of performances. Fun and enjoyment in science activities can never condone or permit careless horseplay in such endeavors. A former Whiz Kid cited this lesson from 22 years ago: “I remember getting in trouble with my best friend because we were throwing the rubber stoppers back and forth across the room during club time. By the way, Mrs. Kralina is a saint for putting up with the two of us.” (80)

In personal interviews, 18 former SSWK were questioned in more detail about the safety issues involved in their demonstrations, asking them, “Did you ever have any safety concerns while performing your demonstrations?” All of these respondents stated that they never had any safety concerns at any time during their club activities. One cited an increased awareness of safety issues and two mentioned their consistent use of safety goggles during their presentations adhering to the guidelines given to them during training sessions. One remarked about the extra precaution needed when he used an extension cord for a demonstration and had to monitor it as a potential tripping hazard. In fourteen years of operation, over one hundred performances, and up and down countless staircases, the club encountered only a few broken beakers, one ripped costume, one high-flying cork when excess acid was used in a demonstration (my fault in measuring) and two snowstorms.

Some studies lament that ECA participation and its benefits are being manipulated by school personnel and parents (Marsh, 1992; Jones, 2004). Even though three (3%) former SSWK club members indicated that they joined the club for resume building, there appears to be little evidence of manipulation by others on the club (perhaps it was the 6:30 AM practice sessions which made it more difficult for parents, not more convenient for them). It is important that parents as well as students are aware of the considerable time and effort that goes into the organization, preparation, training and performances of an active science club. Perhaps selective admissions prevent students using ECA just as a one-line entry to build a resume, or parents using it as free babysitting service.

Studies stated that one of the biggest problems facing ECA was the inability to find teachers that are willing or capable of sponsoring such activities and the inability to compensate teachers for this extra work (Wilds, 1917). For science ECA, the matter of safety is a major factor that also must be considered. Although this science ECA encountered no safety issues during the years of its operation, it was not due to the absence of hazards, but rather through the deliberate and constant adherence to safety measures. Just as every airline discusses the safety procedures before every flight, every year SSWK began with the safety procedures and rules for the club members and their demonstrations. The safety liability that science teachers must assume in the classroom and especially in science ECA where the environment may be less structured or more mobile has not been previously addressed in any study examined, but may also represent a crucial factor in the reluctance or inability of some teachers to sponsor ECA, and especially for science teachers to sponsor science ECA (Munro & Elsom, 2000).

Timing within the School Year and Costs. Limitations to participation in some ECA could also be in the timing within the school year and costs to participate. The timing of the club events tended to be fairly consistent from year to year but these times with respect to the school year may still have impacted the level of participation for those members involved in sports or other ECA (Darling, Caldwell & Smith, 2005). However, with members wearing school uniforms and having names like Billy Basketball, Sammy Soccer, Randy Wrestler, Bobby Bandmaster, Terri Tennis, Fanny Field Hockey, Rodney

Racer, and Freddie Football, it seems likely that this particular science ECA did not have any serious conflicts with major sport seasons, but in fact, benefited from the additional *costumes* available.

Costs such as uniforms, equipment, and travel are not school-supported for all ECA. If students are unable to pay the costs, this also limits or prevents their participation. None of the literature reviewed address this issue. Cost for participation, however, was not an issue for SSWK because there were no costs associated with participation in SSWK. All equipment and chemicals were provided by the schools and the sponsor provided all costumes, make-up and supplies. Many students chose to provide their own costumes or utilize team uniforms in their presentations. Elementary schools or sponsoring organizations provided necessary transportation and frequently, offered lunch and snacks. Being unable to afford costumes did not prevent any high school student from participating in this science ECA for all the years of its operation, regardless of school size, contrary to assertions in some studies (Crosnoe, Elder & Johnson, 2004; Morgan & Alwin, 1980).

School Size. Many researchers challenge the benefits of ECA participation with increasing school size. The flexibility and elasticity of SSWK is evident by having enough costumes and demonstrations for all the Whiz Kids, even in the large school of 2,300 students as well as in the private school of 500 students. Of particular interest is the comparative number of former members in the large public school (nearly twice as many) to those in the small private school who remembered their character and name, perhaps indicating the additional identity afforded students by being a part of this group within a large student population, where average students didn't stand out much from the crowd.

At its peak, the club was booked four years in advance by elementary schools wanting the program to visit their students. There were also plenty of opportunities to be a presenter if students did not want to miss on school days. Because the club's activities were also viewed by other people as entertainment, several organizations invited us to present our demonstrations at other events in the evenings and on the weekends in addition to the regular school visits. Comments previously listed would tend to indicate that teacher-student bonding still occurred, regardless of school size. The poster on our costume closet door said, "There is always room for one more."

Summary of Engagement in SSWK

This study affirms conclusions by many researchers (Broh, 2002; Chambers & Schreiber, 2004; Mahoney & Stattin, 2000; McLaughlin & Irby, 1994; Posner & Vandell, 1999) regarding effective engagement in ECA, i.e., behavioral, cognitive and emotional. This study identifies positive student gains in psychological development, academic adjustment, healthy lifestyles, alternate measures of academic achievement, interpersonal skills and social networks, positive attitudes and connectedness. Characteristics of typical participants and their reasons for belonging to ECA are identified, with "just for fun" listed as the top reason for joining SSWK. Students remarked about aspects of the club that are similar to those in other studies regarding effective ECA, in that SSWK was a highly structured, adult-supervised ECA with opportunities for skill building, cognitive challenge, and positive social context. The relatively high student-teacher ratio in SSWK indicates that the teacher exerted less control, making the club more for leisure or interest than for academic reasons (McNeal, 1999).

There is a point of diminishing returns associated with over-involvement (Swanson, 2002). To determine if over-involvement contributed to a lack of interest or enthusiasm in SSWK, records were examined for respondents who indicated being involved in several clubs. There were thirteen females and three males who mentioned being in multiple clubs during the time they were members of SSWK. 31% of these females also served in leadership positions and 33% of these male served in leadership positions. The minimal time requirements for this club did not seem to impair students' ability to actively participate in SSWK, to assume leadership roles, or to actively participate in other ECA. The point of diminishing returns must have not yet been reached or the structure of this club did not require or permit over-involvement based on its group performances.

The overwhelming majority of the comments depict a successful science ECA that actively engaged its members in club routines and activities. In the tally of all responses dealing with engagement, 34% dealt with behavioral engagement, 20% dealt with cognitive engagement, and 46% dealt with emotional engagement. Emotional engagement comprised the highest number of engagement responses, according the former club members as they recalled their participation in the club 10-25 years previously. Despite some limitations, females and males alike responded favorably regarding the structure and organization of SSWK, enjoyed its relaxed, welcoming atmosphere as well as its challenges, and related well to its adult sponsor/teacher, me. The most frequent reason for joining the club was for fun, followed closely by interests in science and in teaching. The reasons former members liked the club were similar; that is, teaching, sense of belonging, and fun, with 96% indicating that the club effectively met their needs and expectations. Parents (62%) were generally strong supporters of the club and many actively served the club in various capacities. Former members felt they were successful in teaching physical science concepts to elementary school children and provided evidence to support their claims. In the process, former members perceived that they had also improved their own knowledge of and attitude toward science.

Crossing the Gap

The previous sections of this chapter describe the memories and sample recollections of former members of SSWK that have been arranged and presented with respect to engagement. The organization utilizes the guidelines and definitions for the various engagement components identified in the review of related literature. Club archives have been invaluable in many instances to complement or verify observable actions and behaviors. The survey contained many emotional responses.

The remaining sections of this chapter present the memories and representative sample of quotes to recreate the reality of SSWK for its former members as they progressed along an identity formation continuum, addressing social positioning and trajectories of identification changes that these former members perceived experiencing as a result of their participation in SSWK. The review of the literature offers no precise measures for identity growth, there are no archival appraisals taken during the club operation, and the study instrument does not mark or gauge specific individual development stages. The task of showing progress in identity formation lies in the evaluation and coding of the comments that indicate changes or growth in self-identity. While human identity growth occurs in many directions and is impacted through many venues, this study is limited to and illuminates only those processes and attributes voiced by its participants.

As stated earlier, all comments were coded using the coding schema with tallies of similar coded comments to form a composite for each variable within these topics. Absence or low-frequency of these selective coded comments does not necessarily indicate the absence of growth or unimportance of a memory, but by using a mixed methods approach that presents specific individual insights as well as the most frequently-occurring comments, the reality perceived by SSWK participants can be more fully depicted and comprehended. Overall identity formation scores are computed for each participant as the algebraic sum of the composite social positioning score and composite trajectory of identification score (NP + NT). While the reduction of these complex processes into simple quantitative data cannot possibly represent the entirety of the actual identify formation process, this study uses these measureable indicators as elemental and representative components of the social nature that affects how students behave, think and feel in order to design a more socially constructive theoretical ECA framework, rather than replicate previous models based solely on engagement.

Identity Formation in SSWK

Identity formation during high school is strongly affected by social positioning, which occurs along a continuum beginning with self-concept and the home environment and ending with mature status and characteristics. Social positioning within SSWK is defined as and studied with respect to the new social positions (NP) in which students are placed by wearing costumes, engaging in different actions, seeing events and concepts from different perspectives, investing in collaborative teamwork that established a sense of community and goals, and finally reaching toward a new identity with which they then associate. Changes in their social positioning were recorded as comments that attested to new or improved behaviors, perceptions and actions in a position relative to others. These include working with different people, feeling a new identity as a teacher or 'science expert' to others, seeing things from different perspectives, etc. Actions included taking risks, trying new things, doing things in different ways, working collaboratively as a team with different types of people, not just friends.

New positions entail new trajectories of identification (Lemke, 2000; Wortham, 2008) with different future self-images, educational opportunities and career aspirations. Responses from former club members were examined in order to determine their perception of changes in their trajectories based on the wisdom of hindsight and thoughtful reflections of events that took place 10-25 years ago. New trajectories of identification (NT) in SSWK were recorded as comments that attested to new ways of thinking, feeling and behaving based on perceptions of their future self, their envisioned future plans for careers and education, and reflective changes from their adult perspectives.

New Social Positioning (NP) in SSWK

Entry Level Positions and Peer Pressure. The entry level positions of these former members resemble the various groupings or 'cliques,' (Bishop, Bishop & Bishop, 2004; Eccles & Barber, 1999; Eccles, Barber, Stone & Hunt, 2003; Eckert, 1989). Former members offered self-labels and ascribed meaning or positions to the other students that joined the club (Currie, Kelly & Pomerantz, 2007; Eder & Parker, 1987):

- It's OK to be smart and learn. Let's face it, until the Science Channel came on the air, there were no role models on TV for science/math junkies. It's all about athletes and popularity. The club "let us be us". (61)
- I was always a studious kid and by being in Chem Club (and by being Suzy I was president), other kids got to know me in a different way. Yeah, I was smart, but I could have fun too even if I didn't play sports or dance or cheerlead. . . .To other groups we might have been the "nerds", but together we had fun. (8)
- I liked that it was a group of students from different walks of life/groups. That alone made it fun and avoided the "clique" atmosphere. (16)
- There were different studnets, athletes, band members, thespians, scholars, we were somewhat eclectic, but all enjoyed working together. (21)
- My wife says I'm a nerd. (24)
- Being able to participate with other students who were interested in science even though they were not in the same "clique" as I was at school and otherwise would have ignored me. (12)
- I gained some friends that I did not have contact with otherwise. (26)

The impact of peer pressure was evident in the quotes of the previous section on engagement. Former members told of joining the club to be with their friends, because of their friends, and they attended the first meeting with their friends (Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002; Jacobs, Vernon & Eccles, 2004). Their friends made them do it:

- So as far as I can recall I probably joined because my best friend did. (82)
- [I joined because] Some of my friends were members. (9)
- My friend Nelly of the Nile convinced me to join because she didn't want to do it alone. I'm glad she did, I became Pammy Pumpkin. (14)
- I didn't [want to join the club]! I was too afraid of "dressing up" and being made fun of, but someone ({a boy}, can't remember the last name) said I had to and so I did. (12)

Initial club meetings showed evidence of these cliques as students sat together with their friends, those in the same cliques to complete the club membership forms. These forms requested preferences for squads, characters and demonstrations. Size restrictions limited certain costume selections, particularly Betty Bluebird, Raggedy Andy, Randy Racer, and Princess Pocohontas. Characters/costumes such as Angie Angel, Mandy M & M, Danny (or Dottie) Domino, Big Boy Blue and Corky the Clown were tailored to fit larger members. Demonstrations were grouped by physical science topics and all squads were organized, using the heterogeneity criteria specified earlier. Every member got at least one of their choices in each category. Squad leaders chosen from last year's rolls arranged for their squads to meet. Costumes were distributed at the squad meetings.

Costumes: Introduction. One of the unique aspects of this ECA is that the members wore costumes. As mentioned previously, studies on wearing costumes are extremely limited, making this aspect of the club very contextualized, and not generalizable. While costumes were discussed earlier in the emotional responses or enjoyment of wearing costumes (EEW), at this time, wearing costumes (NPC) is examined based on the functionality of the costumes as a performance strategy and as a way to change social positioning within SSWK.

Wearing costumes was viewed by Whiz Kids on several levels. They made 54 comments (8% of all positioning comments) regarding costumes. Some just liked wearing costumes for the sheer fun of it. Some saw wearing costumes only as a way to get the elementary school children's attention, albeit an important function, to be sure! Others recognized the value of wearing costumes to help the elementary school children to relate to the Whiz Kids and to make the Whiz Kids seem more approachable to the young children. More astute students appreciated wearing costumes as a role they could assume, a role behind which they could hide if need be, particularly if they were shy

Whiz Kids. Discerning Whiz Kids attributed wearing costumes as a role that the high school students were playing, actually giving them an identity, of being another person, of a scientist or teacher with the talents, skills and knowledge associated with that role.

Table 13. NP Variables, Survey Response Percentages Disaggregated by School, Gender, Race, and Longevity where School: A = Public; B = Private; Gender: F = Female; M = Male; Race: C = Caucasian; NC = Non-Caucasian; and Longevity: N = Years in SSWK

Variable	School		Gender		Race		Longevity		
Values	A	B	F	M	C	NC	1 Yr.	2 Yr.	3 Yr.
Liked Fun, Excitement	42	23	39	29	39	19	30	35	71
Costumes – Attention	76	93	79	87	79	94	73	87	86
Costumes – Added Fun	18	27	20	23	24	6	24	27	29
Costumes – Identity	32	33	33	32	33	31	24	37	43
Learned New Things	16	7	11	16	14	6	12	13	14

Whiz Kids offered multiple comments about the impact of the costumes. Ten percent of the former Whiz Kids admitted that they just liked wearing costumes (see Table 11) and many members supplied their own costumes. Of the survey respondents, 6% said that the costumes had no impact or that they did not remember if costumes had any impact, 7% thought costumes were just a club expectation, and 78% recognized that the costumes were used to keep the elementary children's attention. More insightfully, 35% also remarked that the costumes added a fun factor to the club activities, while 42% volunteered that it gave them a separate identity to use while doing their demonstrations, and 1% felt like the costumes gave them a possible fit for a future position. When all the comments regarding new positioning were tallied, 8% of the responses credited costumes as helping them assume a different role, at least within the club and its activities.

Costumes for Fun. First of all, wearing costumes is a kinesthetic experience, according to Bakhtin (1965a), reminiscent of carnivals and some responses reflected this festive aspect. First and foremost, the respondents indicated that they liked being members of the club because they had fun, it was exciting for them, and they enjoyed the activities. One former member still enjoys her costume and keeps it handy. During our interview, she pulled out and put on her old costume so I could take her picture in it. It still fit surprisingly well after four childbirths.

As shown in Table 13, some pointed differences occurred between the groups monitored. Nearly twice as many public school members as private school members indicated they had fun belonging to the club. Similarly, nearly twice as many Caucasian members as non-Caucasian members indicated they had fun being in the club. Nearly 25% more female members than male members indicated that they had fun. Longevity showed an exponential rise in fun the longer they were members in the club.

Costumes for Attention. In addition to having fun themselves, Whiz Kids wore costumes to get and hold the attention of the elementary children. As shown in Table 13, private school members and non-Caucasian members were 25% more likely than their counterparts to recognize the value of costumes in getting and holding the elementary children's attention. More males than females noted the attention-getting qualities of the costumes. Longevity also increased this awareness. This pattern corresponds to the pattern observed earlier for those interested in teaching the children, except for one important difference. Female members expressed more interest in teaching, but made fewer references to costumes needed for attention-getting. This might be due to their comfort level in working with small children or that costumes were more memorable in the wearing than in the attention capability, i.e., more females than males made reference to how they looked in their costumes. Some former Whiz Kids discussed wearing costumes primarily as a way to get the elementary children's attention:

- The costumes made us more appealing to the young audiences. (1)
- I think we probably held the kids attention more with our costumes. We were different, a novelty for the day. (3)
- The costumes added a "fun" element that made the kids more interested. (6)
- Probably made it funner for the kids. (53)
- I think the presentation training, along with the costumes were significant in getting and keeping the childrens' attention. (48)
- The costumes were the attention grabber and the experiments were exciting enough that kids paid a lot of attention. (90)
- Made the science seem like magic for the kids until you explain it. (50)
- Kids loved it were hooked before you spoke. (69)

Costumes for Community. Bahktin (1965d) also suggests that donning costumes offers a sense of timelessness that makes each person feel they are a part of community, rather than separate individuals. Some of their responses also included emphasis on costumes as a way to increase the children's comfort in interacting with the Whiz Kids during their performances. As shown in Table 13, members indicated that costumes made them more approachable by making it fun for their young audiences. Members gave responses that followed patterns evident in the previous comparisons, with one notable exception. Non-Caucasians who were adamant that the costumes were for attention-getting seldom spoke of the costumes for the extra dimension of fun that they added, for both the elementary children and the Whiz Kids wearing them. Members with increasing longevity showed increasing fun with costumes. Whiz Kids made these comments about the 'user-friendly' factor of costumes in developing community:

- It made it more fun for the kids, we became more than just people, we were superheroes or characters from books. I think it helped them remember our demonstrations. Instead of just, that guy with blond hair, he was a lightenining bolt! (67)
- The cosutmes peaked the interest of the younger students and gave the Whiz Kids the impression of being approachable and fun. As a result, the science demonstrations that we were presenting could also been seen as fun and accessable. The costumes made it possible for the students to relate to the Whiz Kids and to become engaged in our presenations. If the the younger students didn't have a reason to relate to the Whiz kids, we may have appeared to be intimatating and distant to the younger students. (7)
- The costumes made it relate to the younger students better. (38)
- The costumes made the presenters entering the classrooms less scary and more approachable I think the kids could focus less on us as strangers and more on the demonstration. (91)
- The costume (in my case especially with all of the flair and color) had a big impression on the kids. It lended some authority to what we said, even though we were just a few years older than them. (61)
- I believe it was the "magic" of the whole program. Without the costumes, the kids would have taken more time to warm up to the presenters. (48)
- Costumes, in my opinion, help create an initial bond with younger students and created an initial atmosphere of comfort. (41)

Costumes for Comfort. In building this sense of community from their perspective, former Whiz Kids saw wearing costumes as a way to also help themselves get comfortable interacting with the elementary school children, to get into their role, so to speak. Their responses discussed this comfort level and the roles they perceived that they played for the children:

- I think that the costumes helped the presenter be more comfortable teaching little children and allowed them to be more entertaining. For the audience, I think that it made them feel more comfortable in asking questions and participating in the questions. (81)
- It probably added some confidence to demostrators, because you were pretending to be someone else during the demo. I know I liked to pretend to have a bullfight with some of the students to engage them in the program. (49)
- I think that wearing costumes definitely had an impact -- it caught the attention of the school children and made the Whiz Kids more self-conscious (in a good sense...I mean that it had the effect of keeping us

on our best behavior -- which is subject to interpretation, I'm sure -- and keeping us aware of our responsibilities to the club). (78)

- Ok, being real, I don't think I would have done it without the costumes. They are just fun. (26)
- The costumes were awesome. It was fun to create a character and then follow that with a wild and crazy costume. Characters and costumes allowed us to express our individual personality. I could have done without the rosy red cheeks but I dealt with it. . . .They were colorful and they set a great stage for the demonstrations. It also put us in the mood to perform. (80)
- I thought the costumes were a great touch. The studnets wrote the letters to the characters as if they were real. I was more relaxed explaining things as a character than as myself. It helped to disconnect from everyone watching you and what you know to this is ______ and they are going to show you __________. You could just relax. (21)
- The costumes were the best and I think it really got the kids interested and the students (members of the club) would actually get more into the production. (39)
- The impact would have been diminished. When you put on a costume, it's pretty all or nothing. You're already dressed up, you might as well get into the activity. if participants were in street clothes, their involvement would most likely have been lackluster. (65)
- We could be more playful with the kids when we presented our demonstrations. It was more like story telling and less like learning science. (35)

Costumes for Carnival. Wearing costumes also helped high school students to hide from view. Bakhtin (1965b) also argues that carnival is the place for working out a new ways of relating to people and that standing outside of a culture looking in helps people to understand their own culture. Standing outside a culture to understand a culture may also apply to standing outside one’s self to better understand one’s own self and abilities. Some Whiz Kids spoke not of roles to play, but rather of the need for roles, characters, masks to hide their own identity, so they could stand up outside of their own culture and find new ways to relate to their young audiences.

While it is surprising that nearly one third of this science ECA members disliked science, it is also surprising that one out of every seven reported feeling shy, yet joined a science club focused on performing in front of audiences. Their comments included these disclosures:

- It gave me, a shy person, the chance to 'hide' in a persona or costume while speaking publicly. Also: the children we were teaching, I'm sure, were more entertained by us in costumes than if we were dressed in regular street clothes. (70)
- I do remember preparing myself to dress up in costume and be willing be out of my comfort zone. (24)
- Loved it - wouldnt have done it without costume. I am introverted - costume allowed me to perform. (57)
- The costumes I think were almost more important than the science. The costumes allowed high school students to get into a character which allowed them to escape their own personality and stage-fright easier. (54)
- The costumes took away the barrier that sometimes exists between various age groups and allowed high school students who might otherwise be shy a way to be outgoing. (84)
- Costumes created a fun environment and may have lost some inhibitions (especially of the guys). (13)
- For people who don't like public speaking, it was a great way to get used to it without the stress of speaking to a bunch of adults. And along those lines, if one of our presenters was afraid of performing and embarrassing themselves, they could always remember that it wasn't, for example, "{my name}" performing, but instead it was "Korky the Clown" who was performing, which also helps take the edge off. This wasn't an issue too much for me, but I know 2 people on my team where this definitely helped get them through the first presentations until they became more comfortable with the idea of public speaking. (22)

One former member explained his cover-up this way:

> What was nice is that you were up there in character and you weren't necessarily yourself. You had something, in a sense, to hide behind. I was Freddie Football and I had another personae that I could keep calm in. It didn't matter if they knew me or not. There were probably a couple of schools where some of the kids knew who I was because they were siblings of friends, but for the most part, they had no clue. I was just this guy in a football jersey with the eye black under my eyes and showing them science stuff. So you got to hide behind something, and build those skills, and just have fun in front of them. (I-11)

Costumes for New Identities. Finally, wearing costumes allowed Whiz Kids to take on new identities, if only temporarily. Bakhtin (1965c) ascribes carnivals as unifying connection between a community of participating individuals free of social positions where all are equally important, where rank and regular conventions are set aside and genuine dialogue becomes possible. Each character has a voice, is heard by, and hears others. SSWK built a sense of community with all the characters being equally important in such processes as ‘door rushing’, crowd control, teamwork and peer support. Being equally important and heard by others was depicted in previous survey comments and built self-esteem, an important process within ECA and particularly for gifted students (Powell, 2004; Olszewski-Kubilius & Seon-Young, 2004). Some club members dressed in their costumes and free of their social positions perceived that they actually were assuming different identities, unique identities with different ways of relating and latent potentials (Wertsch, 1991). While role-playing these identities, Whiz Kids had the opportunity to take on the values and check the ‘fit’ of the personae (Guest & Schneider, 2003; Rounds, 2006). As shown in Table 13, wearing costumes to assume an identity was uniformly recognized by all groups, with longevity definitely enhancing this perception. Former Whiz Kids had this to say about costumes and identity:

- My thought was (and is) that costumes were critical for bringing children in and engaging them in the demonstration. I think there was also something to be said for high school students using that change of costume to step into a role of a scientist. As I mentioned in a previous question, there was an expectation there that you would take these things seriously. Stepping into a costume gave them a physical reminder of that expectation. (2)
- So important for self-esteem! You could "be" someone else and not have to worry about your own standings within the school cliques or what clothes you wore. You could say or do anything with less fear. The club would not have been the same without the costumes. (12)

- This is an excellent way to engage children while building the self-esteem of high school students. (87)
- The costumes definitely helped make it a memorable experience for the kids. It also made it easier for me to give the presentation because it wasn't me giving it, it was the bunny. (25)

Costumes: A Summary. As indicated by survey analysis, wearing costumes as a strategy shows a moderate, significant correlation to positioning ($r = 0.404$, $\rho = 0.000$), meaning that those who referenced the importance of wearing costumes (NPC) were somewhat more likely to be those who perceived more changes in their overall new social positioning (NP). There are three outliers to this finding, three members who voiced stronger than average support for the costumes and their function:

- Without the costumes, the presentations would not have succeeded as well. These topics were often complex and had we just been standing in front of children in normal clothes, it would have been harder to hold their attention. Also, the costumes gave the group some personality and a bit of a brand. We all may dress well in normal clothes, but "Linda and Her Students" doesn't sound nearly as much fun to a 4th grader as "Suzy Science and the Whiz Kids". And as I stated previously, watching your best friends put on makeup and dress up in a silly costume was always funny, no matter how many times we did it. It definitely helped take the monotony out of the process and made the presentations something to look forward to instead of something to dread. (22)
- No- the costumes were teh attention grabber and allowed kids to think outside the box. It allowed them to think bigger instead of just another person standing in front of them. I often had kids touch my costume just to see what it was all about. (30)
- The costumes allowed the wearer to be someone else. You might be a quiet person, at heart, maybe a little shy even, but with the costume, you weren't you anymore, you were someone different and could act outside of the manner other people tended to expect you to act. (45)

From the survey analysis, wearing costumes as a strategy also shows a moderate, significant correlation to cognitive engagement ($r = 0.414$, $\rho = 0.000$), meaning that those who referenced the importance of wearing costumes were somewhat more likely to be those who were more cognitively engaged in club activities. There are two outliers for this finding. The first one is the member (22) whose position on costumes was given earlier and the second outlier is the former member who offered this viewpoint: "The costumes, while a little nerdy and embarrassing I will say, helped make the program fun and unique. Without them I think Suzy Science would have been just another science club." (37) There are only weak correlations for wearing costumes as a strategy with behavioral and emotional engagement.

New Actions: Introduction. Identity can be developed through selective ECA choices (Bishop, Bishop, & Bishop, 2004; Eccles, Barber, Stone, & Hunt, 2003) as individuals learn new things, particularly about themselves (Waterman, 1984), participate in new experiences, and find new applications (Hart, 2005). Higher mental functioning in an individual derives from social life (Vygotsky, 1978) and mental actions are socially situated (Bruner, 1990). Similarly, these former Whiz Kids found that in these new social positions with SSWK, they engaged in new actions, actions in which they learned new things, had new experiences and found new applications for concepts.

New Actions: Learned. As shown in Table 13, survey respondents indicated what they liked best about the club was that they learned new things. These responses were made nearly twice as frequently by public school members and male members than their counterparts with surprisingly few responses from private school members and non-Caucasian members. Responses showed a direct relationship of longevity and learning new things, building perhaps on Lemke's (2000) precept that repetition increases fluency and literacy. He maintains that a single interaction is momentary, but strong interactions or those that occur again and again in a lifetime become basic to identity and make up the thing called Self. Respondents told of the new things they learned, sometimes through repetitions of many performances before they owned them:

- I was encouraged to challange things that I disagreed with. I learned that it was acceptable to disagree and object to things that I did not agree with, as long as it was done in a polite, intelligent fashion. I learned that it was acceptable to have a dissenting opinion, as long as that opinion was well thought out. (64)
- I recall that the more involved the children/audience were involved the more they loved it. (5)
- I found that I learned better when I could get my hands on something and wanted to pass that idea along. (29)
- The first time, I talked too fast, and didn't ask questions to let the kids interact. Towards the end, I really knew how to 'work the crowd'. You got to where you weren't afraid to pick the kid who looked ticked off at the world, he wanted to participate as much as everyone else, especially when there were no 'wrong' answers, there were only answers that were okay, and needed more information added to be better. (45)
- Yes, there was always something that could be done a little better. Mainly it was time - speed up/slow down, timing - wait before moving on to let the kids process the joke you just told or see the experiment really work, and how to handle an excited bunch of kids but yet keep them focussed on the purpose of the experiment. (80)
- Learning how to taylor my presentation to the differing audience (from 6th grade to kindergarten) helped me to learn how to tutor someone. I helped many other students in college learning calculus. I could even help over the phone doing double integration. I never just gave the answer, but was teaching them at their level. (8)

New Actions: Experienced. Students need a sense of urgency, purpose and meaning in ECA with hands-on activities and high-interest topics (Cushman, 2006). Study respondents also made comments about how the different actions in these positions provided new experiences for members of SSWK:

- I was more able to get up in front of people to talk. I was quite shy in the beginning and transformed into Suzy by the 3rd year. I was then introducing the club when we did presentations in places other than the grade schools (like the mall one time comes to mind). I liked my topic and felt it made people listen when they would have ignored. (8)
- The fact that they could recite experiments back to us! Or if we had visited a previous year- they would remember the experiment and the

principles behind it. (Also if we had changed character they would remeber that too- and we'd have to do some fast talking!) (23)

- Of course it was fun to get out of class, but it was really cool to do things that made young children happy and interested. (27)
- Because I'm not really a "science" person. I don't think I would have tried some of the things, if it wasn't for Suzy Science. (51)
- My participation in the club did increase my knowledge of science. If I was curious of how something worked, I was more willing to ask. (81)
- Dressing up and seeing the pictures of me and my fellow classmates yeas later. Also, having the opportunity to teach others what I had learned. (88)

New Actions: Applied. Identity development can be facilitated by discussions of curricular themes in a classroom (Wortham, 2008). Respondents indicated how they were able to make new applications based on these actions in their new positions with SSWK. They could actually put into practice concepts they had learned previously or apply procedures that they had observed teachers use with students. They explained it this way:

- They [elementary children] got into what was being taught. They talked about what was happening. Some of the lessons may have been outside their grasp initially but we were able to get them to start talking about what was happening and relate to what they already knew. . . .We would wander around and help to make sure that their attention was directed in the proper direction and tried to involve as many as we could. (29)
- While we did get out of school, and who doesn't like a field trip, we had to win over the students that we were visiting. If we didn't do a good job, there would have been no need for the club. It was an excellent way for high school students to show that they had leadership and teaching skills by using them in a real setting. (54)
- I would argue that the visits were important in sharing scientific concepts with younger students through a more fun and interactive delivery than a typical lesson and it served to reinforce that information for us. (55)
- We generally stuck to the same presentation, it helped things flow more easily. We did taylor them to the audience, though, making changes if necessary for older or younger kids, based upon their ability to participate & understand. (67)
- Enjoyed learning about the experiments. I was amazed about the science behind the experiments. (86)

New Actions: A Summary. Overall, respondents made 149 comments (23% of all positioning comments) regarding the new actions (NPA) they had taken as Whiz Kids. Based on survey responses, there is a strong, significant correlation between positioning and new actions ($r = 0.795$, $\rho = 0.000$), meaning that those who perceived that they had engaged in more new actions, such as those described in the comments that follow are more likely to have perceived more changes in their overall social positioning. There is only one outlier to this finding, but still a very strong supporter of the finding. This former Whiz Kid described the new actions in which he engaged, particularly in learning together as a team: "We all were equally ignorant of how to deal with children early on, how to make the Scientific Method fun, etc., so we all were willing to listen to the ideas of others to make our presentation as enjoyable for the students as possible." (22)

There is also a strong, significant correlation ($r = 0.687$, $\rho = 0.000$) between new actions and overall ECA engagement, meaning that those who engaged in more new actions are more likely to be those members who were overall more actively engaged in the club, with only one outlier, a former member who offers emphatic support of this finding, as shown in the previous comment (22). New actions scores show moderate, significant correlations with all three components of engagement, namely behavioral, cognitive and emotional ($r = 0.457$, $\rho = 0.000$; $r = 0.591$, $\rho = 0.000$; and $r = 0.563$, $\rho = 0.000$, respectively). This means that those who engaged in more new actions are more likely to be members who were more behaviorally, cognitively and emotionally engaged in the club. There are no outliers for behavioral or emotional engagement correlations. The correlation between cognitive engagement with new actions has only one outlier, a former Suzy Science who stressed the more emotional, creative aspect of the club rather than the cognitive aspect: “It [SSWK] allowed me to look at it [science] from a fun perspective instead of looking at it as being such work i.e. memorizing etc.” (30)

New Perspectives. Role play, or make-believe is important for cognitive development and that by projecting ourselves imaginatively into the situations of others, we learn to explain and predict the behavior of others (Currie, 1991). New positions are difficult to assume if students have never considered the other person’s perspective or point of view (POV). Former members discussed the different points of view of elementary school children, teachers and themselves during their interactions within the club. All totaled, former members made 278 comments (43% of all positioning comments) regarding changes in perspectives in their new positions as Whiz Kids (NPP).

New Perspectives of Elementary School Children. First, they offered some assumptions from the elementary school children’s perspectives, of how the elementary children thought and what they liked and learned, particularly with respect to the Whiz Kids’ efforts. They described those perspectives this way:

- I loved being part of Suzy Science. I liked going to other schools and making Science fun for younger children. I also think the younger children loved that we were dressed up in characters. I think it made all of us more relateable to them. (44)
- I remember children crowding around us. I can't say for sure if they learned, but if one looks at the effects of Sesame Street maybe similar to Suzy Science? (14)
- I would say we opened the door for them to be curious about it and see that there was more to it than just something in a book. (82)
- It [SSWK] was a way to jumpstart a young child's mind about Science. (66)
- These may be kids but they always asked great questions. The kids might have done something similar in Scouts or with an older sibling and they wanted nothing more than to let you know what they knew. You had to be knowledgeable about the experiments and ready for detailed questions. (83)

- They were very enthusiastic and to me, when you are able to get children enthusiastic about a subject, they are learning somethign. (54)

New Perspectives as Teachers. In these new positions, many former members' responses started to sound like a teacher's perspective, one of a teacher evaluating a lesson and the students. The Whiz Kids' teacher POV was voiced in these remarks:

- Trying to teach something to school children made me reflect on how my behavior and level of attention affected my teachers in school. (78)
- Different members of the squad had different abilities, both social and academic. The class clown of our group appealed to the attention starved. The sensitive appealed to the less popular. and so on (70)
- We were not worried or preoccupied with individual performances. We were more focused on doing or presenting for others. The focus was how are we going to demonstrate things and what we wanted students to know versus what we could tell studnets. (21)
- I know for a fact that once I was able to get some audience feedback I was able to tweek my performace to what the audience liked, disliked and kept their attention. From first show to last, I think my delivery was much more smooth and relivant. I was able to communicate exactly what my expirement entailed, why it worked and what made it so in a much more sccinct and interesting way. (46)
- After building some confidence and having gone thru the spiel so many times, I had a lot of lines I used that would get the kids laughing or more interested. (77)
- We still had to keep up with our work and sometimes missing important lectures for these field trips. But it was worth it because the elementary school kids were so appreciative and it was great to see them engaged. (33)
- I know that the students were engaged because we never seemed to have problems with discipline. The students were excited to volunteer and usually very eager to participate. (15)
- I would say the vast majority of the children in attendance were more than engaged--most were in awe. Their high level of engagement was directly related to the vehicle through which the learning was taking place. It was a combination of the characters (costumes), the interactive experiments, the real-life applications, the entire experience. For many it was evident that science had suddenly become interesting to them for the first time. (62)
- Obviously it is not possible to hold every child's attention all of the time. It is not possible to hold some children's attention for more than a few minutes at any time. Different members of the squad were more effective than others, but we all began to learn what worked and what didn't. I believe the way we entered, in costume, grabbed immediate

> attention. The students gave us the opportunity to start with their full attention and we just had to exert the enthusiasm and energy to keep it. Each time the character changed, we got a fresh start at grabbing attention. (26)

In these new positions and from a teacher's perspective, Whiz Kids also observed changes in the elementary school children's behaviors that Whiz Kids perceived as evidence that the children's points of view (POV) had also changed. They saw these changes in the children:

- The kids were stand offish at first and then you saw them slowly coming around then there were ooos and ahhhhs and then they were smiling and then they were raising their hands and asking to participate. . . . you could literally see the trasformation right in front of you. . . .Watching these young children being very passive and trying to act like the experiments weren't interesting- only to watch their faces change to smiles of amazement. I could relate to those kids because I thought I was too cool to learn and these kids were totally engaged when you showed them something that was new and extraordinary. (30)
- The evidence of many children's long, sad faces turning into bright and broad smiles, roarous laughter, the popping like fireworks of their eyes, like a light bulb coming on, clapping, misbehaving children behaving, reclused and quiet children coming out of their shells and asking questions, aiding in our presentations. (76)
- Some demos we allow the children to try them. You could see a light go on in their ideas when they proved to themselves that what you said was true really was. (49)

New Perspectives as Themselves. But most of all, these former Whiz Kids discussed the changes in their own POVs in these new positions, how the experiences made them think new thoughts, see things from a different perspective, and appreciate the POVs of others. Their POVs changed this way:

- During the presentations, I found that I really enjoyed watching young children experience the wonders of science. Through previous jobs and experience, in middle and high school, I had known that I liked working with younger children. However, this club gave me the opportunity to experience how much excitement and awe science could inspire in younger children. (7)

- I don't know that it increased my knowledge base but it allowed me to think about the subject in a different way. (37)
- I found out ways to think about science in my daily life. I enjoyed the experiements. (34)
- You did get out of school but you were not out playing around. You were actually helping to explain science to younger students so in a sense, you were still in school, just not your own. (18)
- I love to teach children and experience new things through their eyes. It was a great learning experience for me. (50)
- I think it kept me interested in the sciences and showed me a unique way that you can mix science and fun. (90)
- I guess it made me more open to looking at the world with different questions in mind. (8)
- It must have been working on different activities, and knowing how things work. If I recall correctly we were all over the school and possibly even a field trip looking at things through a scientific eye. (56)

In these new positions and engaging in these new actions, Whiz Kids found new meanings and values. They started changing their POVs, which fostered the growth of resilience, a characteristic that increases their potential for success in school and other life accomplishments despite environmental adversities (Mahoney, Cairns & Farmer, 2003; Reis, Colbert & Hebert, 2005). Respondents described it this way:

- Bringing science into the limelight and making it something fun the learn not dreaded. That is how I view science as something exciting and I was so happy to have that opportunity to share that with others. (28)
- All I wanted to do in the first demonstration was to remember my lines and hope that my experiment worked. By the time I completed my final demonstration, the lines didn't matter nor the success or failure of the experiment. In fact, some of my most memorable experiments didn't work at all but were successful because the kids loved it. What mattered at the end was having fun with the students and creating a buzz of excitement and interest surrounding science and the Whiz Kids. (80)
- We visited an elementary school and were mulling around in the hallway shortly after the presentation. A few of the students stepped outside to walk down the hall and were talking about how "cool" we were. That was the exact time in my life when I fully realized that peer programs worked and had an impact because we weren't "cool" kids,

we were completely average students that showed the subject to be "cool". (16)

- Over limited time, I did a better job of relating to the younger children than at first, capturing and holding their attention and using age-appropriate humor. (91)

During role-play, students build knowledge, skills, discourse patterns, dispositions, and feelings and later, these qualities become integrated into private thought, covert behaviors, and a shared consciousness, fostering identity formation and abstract thought (Pinciotti, 1993). Former club members offered comments that depicted their retrospective point of views about the values they placed on certain interactions and actions from their positions and role-play in SSWK:

- Probably if I'd been in the club longer, that alone would have increased my interest in science. (27)
- I can not imagine the club would have had the same impact if we had not been wearing costumes. Suzy Science was so unique, in part, because it made the subject of science so fun and memorable for the kids. The costumes were a critical and in my estimation necessary ingrediant for ensuring their Whiz Kids experience would be one those in the audience wouldn't soon forget. (62)
- It was actually work to try getting the kids interested and carrying all the equipment around. (85)
- Sitting in a classroom is much, much easier than carrying equipment, carrying/wearing costumes, and energizing students. You have to thoroughly enjoy it. (13)
- I think that a younger student seeing a student just a few years older taking an interest is very important. It helps them to feel less of an outcast in taking an interest in something academic. (56)
- Some were very bad presenters and did not engage the kids, it is important to really like kids. (72)

New Perspectives as Peers. From their new positions, former Whiz Kids discussed POVs of the elementary school children, teachers, and themselves, but none of their peers. Even though squads were eclectic mixes of people with different social positions, none of the respondents mentioned their peers' POVs, or how they may have been changing their POVs, such as they had witnessed with the elementary school children. The former members did however note several times how well all the Whiz Kids got along with each other. Perhaps this is more indicative of changes in their own POVs from a social positioning perspective that dictates with whom they could talk and work, a morphing of social positions that were different from their entry level social positioning. Many responses made reference to the new friends they had made, as shown in previous sections. When asked what they liked about the club, 22% of the respondents mentioned the new friends they had made and 44% mentioned the feelings of belonging and social value they had while working in the club (see Table 11), but there was no discussion of any change to their entry level social structure identified initially.

New Perspectives: A Summary. As indicated by the survey results, there is a very strong, significant correlation between positioning and POV ($r = 0.814$, $\rho = 0.000$), meaning that those members who more consistently considered the POV of others were highly likely to be those who perceived more changes in their social positioning by participating in the club. This very strong correlation has only one minor outlier. This member made very few responses regarding the points of view of others, but did notice changes in her own perspectives over time: "It [SSWK] was interesting and worthwhile and I think I enjoyed it even more than I thought I would." (19)

POV scores also show moderate, significant correlations with cognitive engagement and overall ECA engagement ($r = 0.529$, $\rho = 0.000$; $r = 0.489$, $\rho = 0.000$, respectively), meaning that those members who more consistently considered the POV of others were somewhat more likely to be those who were cognitively engaged and those overall more engaged in the club. There are no outliers for overall ECA engagement and POVs. Only one minor outlier for cognitive engagement and POVs, a sensitive and gifted former member with a very high cognitive score who spoke about the needs and abilities of individuals, rather than addressing general POVs. She explained her thinking:

> Obviously it is not possible to hold every child's attention all of the time. It is not possible to hold some children's attention for more than a few minutes at any time. Different members of the squad were more effective than others, but we all began to learn what worked and what didn't. I believe the way we entered, in costume, grabbed immediate attention. The students gave us the opportunity to start with their full attention and we just had to exert the enthusiasm and energy to keep it. Each time the character changed, we got a fresh start at grabbing attention. (26)

Thus, the data tend to support the finding.

Teamwork. Teamwork and social skills are important facets of identity formation as well as initiative, peer relationships, and understanding others (Dworkin, Larson & Hansen, 2003). Teamwork and other life skills were also given as rationale for the high parent support of ECA (Bishop, Bishop & Bishop, 2004). Although studies assert that accessing new social positions essentially means the individual has to become an entirely different person, SSWK members seemed to easily assume new social positions with their character identities. Table 4 presents responses indicating high levels of squad cooperation. Teamwork that may have begun as a standard operating procedure to just get along with others, as shown in previous sections regarding BEW, now seems to have escalated into an overriding sense of community for the Whiz Kids (NPT), verifying the importance of connectedness and collaboration (Berkowitz & Simmons. 2003; Hart, 2005; Marsh, 1992; McNeely, Nonnemaker & Blum, 2002).

Regardless of school size and studies to the contrary (Crosnoe, Johnson & Elder, 2004), former Whiz Kids attested to their outstanding teamwork in comments like these:

- I rememeber most kds in the group worked well together, and kind of formed our own path. (64)

- I loved being with the group. We would practice our demonstrations for each other to see if we were doing it right and to see if we could answer the questions our audience might have. (35)
- How friendly everyone was to each other and how we were able to help each other out especially when it was your first time and you were nervous. . . .We laughed at each other and helped each other out. (42)
- I feel our squad did as best we could with the information provided to engage as many students as possible. We would critique our performances on the bus back to the high school and I think this helped a great deal. (54)
- All the students in the squad were similarly intersted in science. Also, the students who chose to participate in the club because they were the type of kind-hearted student who enjoyed working with young children. Because the club brought together such students, we communicated and worked together well. (7)

In all, the respondents made 44 comments (7% of all positioning comments) regarding teamwork. The survey results show a strong, significant correlation between positioning and teamwork ($r = 0.706$, $\rho = 0.000$), meaning that those members who emphasized the importance of teamwork during their performances are very likely to be those members who perceived more changes in their social positioning. There is one minor outlier to this finding, a former member who scored high on positioning, but emphasized point of view nearly two and one half times more than teamwork. Once she felt accepted for who she was, she became more self-confident. She admitted to learning from all her colleagues when asked what she liked best about the club:

> Being able to use my creative skills without being considered strange or different. It was okay and encouraged to be different and you could pass that on to the kids who were watching your experiments. I really enjoyed the variety of students who were involved from the program and learned something from each one of them. (30)

Thus, the data still support the finding.

In addition, teamwork scores also show moderate significant correlation to cognitive engagement, emotional engagement, and overall ECA engagement ($r = 0.442$, $\rho = 0.000$; $r = 0.412$, $\rho = 0.000$, and $r = 0.526$, $\rho = 0.000$; respectively). Those who worked collaboratively toward a common goal and built a sense of community were somewhat more likely to be those members who were cognitively, emotionally and overall more actively engaged in the club. There are no significant outliers for teamwork with overall ECA engagement or cognitive engagement. There is, however, one minor outlier for teamwork and emotional engagement. This one apparent deviation from the finding may actually have been due to the phraseology used in her responses, for she did show the highest overall emotional engagement score and specifically commented on the kind-hearted members of the club, but did not specify collaborative teamwork that could be coded, following to the coding schema. However, when asked what she liked best about the club, she responded: "The interaction with the other members." (7) Thus the data still support the findings.

New Identities. The positioning process within SSWK began by wearing costumes. That was augmented by taking new actions, looking at things from different perspectives, and collaborating as a team. The final outcome for the club participants was hopefully, a new social position, or an identity with new characteristics. New social position identities (NPI) were coded for responses that described perceived changes in relational positions, be it with respect to elementary school children, friends, parents, other adults or peers, teachers, or just people in general, changes of a more permanent nature, not just for that day or time, nor based on physical attributes. A qualitative approach in looking at comments helped to discern some changes rather than merely counting those comments with the word, "changed," just as noticing that the spelling and grammar in the responses improved dramatically as the questions probed deeper. The perceptions about their new or redefined social positions (not through simple biological maturation, but based on their participation in SSWK) were based on increases in interpersonal skills, new circle of friends and, presentation and leadership skills, teaching skills, and science expertise.

New Identities with Interpersonal Skills and Self-Esteem. First of all, their new identities (NPI) were based on increases in interpersonal skills and self-esteem, such as described in these comments were particularly evident for several shy individuals, with *shy* being specifically mentioned by 13 (14%) former members. They acknowledged:

- I was a shy individual in high school and kept to myself most of the time. The club allowed me to open-up and learn to teach others. (81)
- I was a shy kid and dressing up in a costume and presenting in front of others started to build my confidence, an experience that has aided me over the years. (41)
- I was an extremely shy gal so doing suzy science helped me not hide and be more comfortable around everyone. (83)
- As an individual at the time I needed every dose of confidence building I could get. (79)
- I was able to practice my interpersonal skills with other and my self esteem was postively impacted. (74)
- It was a way to create early in them the love, the curiosity for science, the anybody can do it feeling, don't give up - you are not a failure that I so badly needed, and through the Grace of God received. (76)
- It was fun. It was a growth experience. It helped me become more outgoing. (11)
- Yes - i was trying to find out what interests me. (42)
- I gained confidence in being in front of people. I was extremely shy as a child, so having to perform in front of other people was a great opportunity for me to overcome that to a certain degree. Also, as mentioned before, developing strong relationships with the other members of the club helped me throughout my high school years. (34)
- I did not have high expectations about joining a "science club." But I had a lot of fun, made a lot of friends, and learned a lot about science and myself in the process. (15)

New Identities in New Circle of Friends. Peer harassment and crowd selection may manipulate social positioning (Bishop, Bishop & Bishop, 2004). However, the club members' new positions or identities were also manifested in the new circle of friends the Whiz Kids developed as a result of their participation in SSWK. Comments describing this component were discussed in an earlier section and in the following remarks:

- The friendships that I forged during my time with the club. (80)
- This group put me with other people that had the same interests as me and gave me a group to belong. That is so important in high school because it is such a time of change and growth. (28)
- As a student who was reluctant to leave school for any reason (I might miss something important!), it forced me to engage with the community and with an age group that I normally had no contact with. It was an expanding experience. (12)

New Identities with Presentation and Leadership Skills. Another dimension of the Whiz Kids' new positioning dealt with increased presentation and leadership skills, as seen in these comments:

- Helped in communication and presentation skills. (47)
- I definitely grew more confident in my communication skills and became a better presenter, as far as speaking clearly and with enthusiasm and learning how to involve the students in a meaningful way. When I started, I was much more nervous and hesitant with my presentation. (19)
- It was a learning experience..for every one involved. helped with public speaking which is very valuable. (58)
- The biggest impact, I believe, was training and experience in preparation and presentation. (26)
- From what I can remember, obviously during my first presentation I was pretty nervous, unsure of myself, and lacking confidence not only in my own presentation skills but in the experiment itself. Of course, after the experience of numerous presentations, I had become much more confident in my public presentation skills and the art of describing a concept while you are demonstrating it. (62)
- I believe it [SSWK] allowed students to discover their leadership skills. (30)
- We learned a lot more than just science in those visits. How to deal with public speaking, how to deal with people participating to little or too much, how to work well in a group. (82)

New Identities with Teaching Skills. A fourth dimension of these new positions for Whiz Kids included teaching skills as evidenced in these remarks:

- The impact these students made on the younger classes was invaluable. Also, in the greater picture, the experiences these high schoolers had in reaching out to the youth of our society is something that will have impacted them for a life-time. (52)
- I feel that it made us more responsible, more accountable, and gave us the feeling that we were trusted enough to leave school and go teach elementary school students. We were trusted to use fire and other elements around elementary children. (92)
- I think it did get us out of classes but at the same time it made me feel like I was positively impacting a younger student and it made me feel good. (44)
- I loved going to the grade schools and "performing" for the kids. They always enjoyed the experiments and loved if we were able to give them hands on practice. In fact you got to be a "celebrity" as many kids would recognize you out of costume in public and begin to ask about your experiment and tell their parents all about the school's visit. (23)
- We had to win over the students that we were visiting. If we didn't do a good job, there would have been no need for the club. It was an excellent way for high school students to show that they had leadership and teaching skills by using them in a real setting. (54)

New Identities with Science Expertise. The final dimension of these new positions involved new positions with increased science expertise:

- I think it was a way for the high school students to be leaders and grow their self esteem as scientists. (32)
- I had a great time inspiring younger children to enjoy and learn about science and related activities. (17)
- It gave me a more practical understanding of the chemicals around me everyday vs the ones in the lab. (50)
- While we did get out of class we did not stop learning. We developed presentation skills through the demonstrations. Writing skills with the thank you letters. Responsibility to a group and others. My science knowledge increased and became more meaningful. (21)
- It [SSWK] solidified my understanding of many scientific principles. You have to know a subject well if you plan to teach it. (25)
- I have never heard any of the students or teachers we visited complain that they didn't get something valuable out of our visits. It was good for the younger ones to see that Science is not boring, and high school

> kids are not a bunch of scary stoners (let's face it - a lot of little kids are afraid of the high school kids, if they didn't have big brothers or sisters). (45)

New Identities: A Summary. Surprisingly, these new identities (NPI) are only weakly correlated to overall ECA engagement and cognitive engagement, but show no correlation with overall behavioral or emotional engagement. This unusual finding may relate to the measuring instrument or the difficulty in assessing positioning changes several years after the event, or perhaps, indicate developing identities, rather than strong well-developed identities at that point in time. Movement along the identity formation continuum is not necessarily constant, uniform motion or the same progression for each participant. Testing newly-formed identities requires stepping out into new territories to see if the new identity still fits and stepping back into the former grooves to see if they still fit there. Respondents made 122 responses (19% of all positioning comments) regarding these new identities.

Based on the survey data, there is a strong, significant correlation between new identities and positioning ($r = 0.600$, $\rho = 0.000$). Those members who perceived a new self-identity (NPI) emerging through their participation were highly likely to be those members who perceived more changes in their social positioning (NP) within the group. There is only one minor outlier in the data, which still tends to support the finding. This former member scored high in positioning but lower in new identity. Her comments indicated she had already explored positions of working with children, so it was an identity refined, but not new to her: "Through previous jobs and experience, in middle and high school, I had known that I liked working with younger children. However, this club gave me the opportunity to experience how much excitement and awe science could inspire in younger children." (7)

New Social Positioning in SSWK: A Summary

Students initially joining SSWK exemplify the stereotypical social positioning identified by many researchers. Peer pressure has prompted several students to join the club and they sit with their friends at the first meeting. Once enlisted, however, squads are formed and costumes are issued. Costumes offer opportunities for fun, attention-getting, a sense of community, comfort in new roles, exploration of interactions and interpersonal skills, and new identities. Whiz Kids, students are engaged in and challenged with new actions where they learn new things, experience new ideas, and find new applications for concepts learned previously. In preparing their presentations, they begin to see situations from different points of view, such as those of the elementary school children, teachers, changes in their own points of views and those of their peers. Reliance on others and mutual responsibility for performances foster the growth of true teamwork and collaboration among squad members. Identities change and become refined as members discover and embrace new interpersonal skills, new circles of friends, presentation, leadership and teaching skills as well as increased science expertise.

Members who showed higher NP scores were those members who experienced the greatest change in social positioning. They also were

1. highly likely to be those members who more consistently considered the POV of others;
2. highly likely to be those members who perceived a new self-identity emerging through their participation
3. more likely to be those who perceived they had engaged in more new actions;
4. more likely to be those members who emphasized the importance of teamwork during their performances;
5. more likely to be those who were more cognitively engaged in club;
6. more likely to be those who were more actively engaged in the club activities

7. somewhat more likely to be those who thought wearing costumes was an important component of the club;
8. somewhat more likely to be those members who were more behaviorally engaged in the club; and
9. somewhat more likely to be those members who were more emotionally engaged in the club.

Members who engaged in more new actions (NPA) were

1. more likely to be more cognitively, emotionally and overall more actively engaged in the club; and
2. somewhat more likely to be more behavioral engaged in the club.

Members who more consistently considered the POV of others (NPP) were

1. highly likely to be those who perceived more changes in their social positioning by participating in the club; and
2. somewhat more likely to be more cognitively engaged.

Those who worked collaboratively toward a common goal and built a sense of community (NPT) were

1. somewhat more likely to be those members who were cognitively, emotionally and overall more actively engaged in the club; and
2. somewhat more likely to be more behaviorally engaged in the club.

Table 14. Summary of All Positioning Responses

Coding	NPA	NPC	NPI	NPP	NPT
Variables	Actions	Costumes	Identity	Point of view (POV)	Teamwork
Total # of Responses	149	54	122	278	44
Percent of Responses	23	8	19	43	7

New Social Positioning in SSWK: Regression Analysis

Based on the coding schema discussed earlier, survey responses were coded, based on the content and evidences identified in their statements. There were 647 comments coded as new social positioning responses (52% of all identity formation coded responses). Tallies were made for each respondent for each of the NP variables and then used collectively to generate a composite NP score based on the algebraic sum of the individual NP variables. Tallies of all positioning variables are shown in Table 14.

Using a multiple regression analysis for overall identity formation scores and positioning as measured by new actions (NPA), costumes (NPC), new identities (NPI), new perspectives (NPP), and teamwork (NPT) yields $F_{(5, 90)} = 94.470$, $\rho = 0.000$, reiterating this strong correlation ($r = 0.921$). After correcting for interaction effects ($r^2_{adj} = 0.847$), this analysis shows that 83.9% of the variance in overall identity formation scores can be explained by these five social positioning variables.

New Trajectories of Identification (NT) in SSWK

According to these former Whiz Kids, the new positions they experienced fostered a wider circle of friends with similar interests and dispositions, the growth and development of personal attributes, presentation, leadership and teaching skills, and science expertise. However, the importance of placing students in new positions goes beyond these immediate rewards to that of expanding their previous trajectories of identification. Changes in the resulting trajectories and thus, interaction patterns are evidenced in more diverse future self-images (NTF), expanded educational opportunities (NTE), and enhanced career aspirations (NTC). A summary of all new trajectories of identification (NT) variables is shown in Table 15.

Table 15. NT Variables, Survey Response Percentages Disaggregated by School, Gender, Race, and Longevity where School: A = Public; B = Private; Gender: F = Female; M = Male; Race: C = Caucasian; NC = Non-Caucasian; and Longevity: N = Years in SSWK

Variable	School		Gender		Race		Longevity		
Values	A	B	F	M	C	NC	1 Yr.	2 Yr.	3 Yr.
Impact on Prof./Pers. Life	3.8	3.6	3.8	3.6	3.8	3.2	3.9	3.6	4.2
References After HS	60	37	57	42	55	38	45	52	86
Ed. Level Reached	3.1	3.7	3.3	3.3	3.3	3.2	3.0	3.4	3.9
Resumes/ Applications	11	23	16	13	14	19	12	17	14
Career in Science	32	17	23	35	26	31	24	27	43
Career in Education	37	23	38	23	36	19	36	27	57
Career in Sc. Education	6	3	7	3	7	0	9	4	0
Volunteerism	82	57	74	65	75	69	78	73	86
Reflections – Personal	47	50	48	48	49	44	33	58	43
Recommend-ations	26	17	21	26	25	13	24	19	43

Future Self-Images. The respondents' comments depicted the perceived changes in their future self-images (NTF). The reader must keep in mind that these future self-images are tenuous statements made by adults reflecting back on their high school years and envisioning how their self-images at that time had changed due to their participation in the club. Their candor and introspection offer insights into experiences that they feel shaped, to some degree, their current status and position, thus, depicting the reality of their participation. These changes in their future self-images show great diversity and are illustrated in these comments by former Whiz Kids:

- Some what helped shape who I am today. (69)
- It was probably the first experience I had in learning to step outside my comfort zone. I think it certainly gave me great groundwork for being confident in public speaking and presentations. (24)
- Really helped me speak in front of people more comfortably. (83)
- I have had to present materials in a variety of ways. This club was great in preparing me to do just that. (25)
- It was always good to be in front of an audience and as I said it was great to rejuvenate my interest in science. (71)
- It was fun dressing up and going to present to the {local elementary school} kids. The Science Center was also a great opportunity, although I don't think I realized at the time this is the only time in my life I will get to present at the {local} Science Center. . . .[SSWK] helped with college apps, helped with public speaking skills, helped with confidence in science knowledge. (14)
- Increased my ability to work in a group, speak to an audience, engage those that may be disruptive or not participating, explore something that I wouldn't normally take on and enjoy it. (82)
- I also believe it allowed us to become better public speakers therefore becoming more confident in our ability to engage others in conversation (30)
- Interacting with children on their level, teaching children by having fun - I use these skills on a daily basis with my 4 year old daughter. (84)
- I volunteer a lot of time coaching and as a scout leader. I'm sure use the stuff I learned in Suzy Science all the time without realizing it. (80)

Overall, survey respondents made 161 comments (27% of all trajectory comments) regarding their future self-images (NTF). There is a moderate, significant correlation between future self-images and new trajectories ($r = 0.590$, $\rho = 0.000$). Stated simply, those members making more comments regarding future self-images were somewhat more likely to be those members who perceived more changes in their trajectories of identification. There are no outliers in the data to refute this finding. There are weak correlations of future self-images with overall ECA engagement, cognitive and emotional engagement, but no correlation with behavioral engagement.

Future self-images (NTF) also show a moderate, significant correlation to new social positions (NP) ($r = 0.422$, $\rho = 0.000$), meaning that members making more comments regarding future self-images were somewhat more likely to be those who perceived more changes in their social positioning. There is only one outlier in the data, which still seems to support the finding. This former member made several comments regarding future self-images while offering this insight into confidence-building: "We had seen the effect our presentations had on the student, and this gave us confidence for future presentations. We knew our science club would be the highlight of their day at school because it was such a unique and interactive learning environment." (62)

Educational Opportunities. While there may be a lack of research on the exact formation of educational aspirations (Hosssler & Stage, 1992), these more diverse trajectories of identifications included expanded educational opportunities (NTE) in addition to new future self-images. Respondents spoke of educational opportunities that range from learning at deeper levels, formal educational pursuits, informal learning opportunities as well as an appreciation for different instructional strategies. Respondents gave 100 comments (17% of all trajectory comments) regarding educational opportunities. Former Whiz Kids identified the educational aspect of their new trajectories in these remarks:

- Seeing Ms. Kralina as a female, as a leader, I'm sure went far to encourage me to do the things that I knew I was capable of. (40)
- The experience was very different from something you might learn in the classroom. I think it is very important that every individual have the opportunity to try teaching in some capacity. (6)
- Yes, I guess it made me more open to looking at the world with different questions in mind. (8)
- I had the opportunity in the club to explore things that I had never saw or knew before, be it my upbringing, or whatever, it helped to open a door. (76)

- I remember being shy with public speaking and I think it [SSWK] helped me to prepare for college and communication. (89)
- Talking in front of people help me get over my far of talking infront of people. Helped in making school fun which help in keeping me motivate in college. (31)
- I was never too interested in Science before joing the club. The club peaked my interest in Science, although I never went on to be a scientist. (43)
- Yes, because we were doing the experiments and had to teach others so we better understand the "why". I went on to take more science in college and got A's in chemistry. I was well prepared with what I learned in high school. (86)

Having experienced a hands-on approach to science, one former Whiz Kid described his college science experiences this way:

> I tried to stay in the lab class, but well, you dropped the [lecture] class so you have to drop this [lab section], too. [But] this is where the fun is. It's the hands-on, I could get that stuff. But I just couldn't do it [the lectures]. You took paper in the lecture hall, that method. In all my science labs, I did great, especially chemistry with the unknowns. I could do unknowns. In five minutes, I had it figured out! And people are still setting up! I said, "This is what it is!" and the guy's [lab TA] like, "Are you sure?" I said, "Yeah! That is what it is." He gets his little book out and matches the number up. "You're right!" He said, "How did you know that?" I said, "You knew the tests had to try, this is the result, this is the result, this is the result, elimination, it can only be that. And if this test you get a certain result, it would lead you to another test, and it's just elimination. He said, "Ohh! Would you like to do another one as long as you're here?" So I did them all! [all the unknowns] Everyone is struggling to get their first one done and I had them all right. I said, "You're having a problem with this! He [lab TA] said how could I do that. And I said, "This is what science is to me. It's doing, hands-on, not just sitting in a lecture hall! NOT WAAA WAAA in a hall. If I can get my hands on it, I can have fun." He was a great lab guy and eventually got a job teaching at the college. I love labs! It was just the classroom lectures that were not exciting! Some [professors] tried more than others. (I-11)

This study has the benefit of exploring not only the opportunities but also the actual educational levels attained by these former ECA members. As indicated by the survey data, 100% attended college, 89% of the respondents have a Bachelor's degree or higher, 52% having a Master's degree or higher and 8% with PhDs or equivalents (see

Table 16). The high educational levels attained by the adult former Whiz Kids tend to confirm findings by Reis, Colbert, and Hebert (2005) that ECA serve as protective factors allowing talented students to achieve at high levels. These high levels also tend to confirm findings by Mahoney, Cairns, and Farmer (2003) that consistent extracurricular activity participation is associated with positive changes in educational aspirations and interpersonal competence. Regression analysis for this study shows no correlation between educational level attained and SSWK longevity, or with gender.

Results tend to support similar findings that after-school activities contribute significantly to the prediction of achievement (Cooper, Valentine, Nye & Lindsay, 1999) while refuting findings of achievement differences due to gender (Bell, 2003). As shown in Table 15, there are no differences in educational achievement based on gender or race. Private school members attained somewhat higher overall levels than public school members. SSWK longevity affirms a direct relationship with educational achievement.

Table 16. Education Levels of Former SSWK Members by Percentages and Code

Highest Educational Level Attained	Percentage	Code
High School Graduation	0	0
Some College Classes	11	1
BS/BA	22	2
BS/BA Plus	16	3
MS/MA/MBA	35	4
MS/MA/MBA Plus	9	5
PhD/JS/MD	8	6

From the survey data, there is a strong, significant correlation between educational opportunities and overall trajectory scores ($r = 0.642$, $\rho = 0.000$), meaning that those members who consistently made more references to educational opportunities were more likely to be those members who voiced more changes in their trajectories. One minor outlier in the data still tends to support this finding. The former member made comments specifically directed toward his career aspirations, only implying his educational opportunities. He explained his aspirations this way:

> I was also doing theater and was going into elementary education, so it seemed like a nice fit to concinue to make sure this was the professional direction I wanted to go in. . . .I think what I walked away with is an appreciation that not only could you understand these concepts, but you had to have an understanding of them to teach it to someone else. (That isn't a concept shared by all elementary teachers I have worked with in the past 11 years.) (2)

Educational opportunities also show correlations to engagement and positioning. There is a moderate, significant correlation with cognitive engagement ($r = 0.465$, $\rho = 0.000$). This means that members who referred to educational opportunities were somewhat more likely to be those members who were more cognitively engaged in the club. There are no outliers to refute this finding. Educational opportunities also show moderate, significant correlation with overall ECA engagement ($r = 0.463$, $\rho = 0.000$). This means that members who referred to educational opportunities were somewhat more likely to be those members who were more actively engaged in the club. The one outlier to this finding is the member with the second highest overall ECA engagement score. Although she did not speak of her own educational opportunities, one member frequently voiced her belief in the educational opportunities or benefits of science ECA for her own middle school science students, such as stated in this comment:

> I enjoy offering students who are interested in science the opportunity to purue their interests. Research devoted to the learning and development of gifted students shows that students benefit from extra-curricular clubs that offer students the opportunity to purue their interests with similarly interested peers. I am able to refer to my positive experience [in SSWK] in support of this research. (7)

In addition, these expanded educational opportunities show a moderate, significant correlation with social positioning ($r = 0.482$, $\rho = 0.000$). This means that members who referred to educational opportunities were somewhat more likely to be those members who voiced more perceived changes in their social positioning. There are no outliers to this finding.

Resumes. Previously, some references were made to resume building as a reason for joining SSWK, but there are no correlations between resume-building and any of the variables in this study. Respondents did make 32 comments (5% of all trajectory comments) about referencing SSWK on college applications and resumes (NTA).

As shown in Table 15, nearly twice as many private school members than public school members referenced SSWK on their resumes and applications. This seems reasonable, considering that the private school stated that every one of their graduates attended college and had a school counselor designated to assist students in applications, such as listing all ECA, writing essays, practicing for interviews, etc. Comparative school enrollments for college counselors would mean 125 seniors per college counselor at the private school versus 600 seniors per college counselor at the public school. Female members were more likely than male members to list SSWK on resumes. Despite making fewer outside references than others after high school, 25% more non-Caucasians listed SSWK on resumes and applications than Caucasian members. Surprisingly, two-year members listed SSWK on resumes more than three-year members.

Career Aspirations. In addition to more diverse future self-images and expanded educational opportunities, former Whiz Kids discussed their enhanced career aspirations (NTC) in these new trajectories from the vantage point of adulthood. Their comments have increasingly improved in spelling and grammar in their responses to the more probing and reflective questions at the end of the survey, more accurately reflecting their educational and professional attainments. Once again, this study has the advantage of exploring not only the aspirations but also the actual careers achieved by these former ECA members (see Table 2).

Respondents made 106 comments (18% of all trajectory comments) regarding career aspirations in their reflections. Responses regarding their career aspirations are grouped by the content areas indicated in the responses and the topics being considered in this study; that is, science and science-related industries, education, and others.

Career Aspirations in Science. Those entering science careers were of particular interest in this study. SSWK focused on physical science topics and had a composition ratio of 2:1 females to males, contrary to findings of Murphy and Whitelegg (2006). It is possible for science ECA to promote an active intrinsic interest in science that is strongly related to a preference for a science career (Hofstein, Maoz & Rishpon, 1990; Jacobs, Finken, Griffin & Wright, 1998; Miller, Lietz & Kotte, 2002; Stake & Mares, 1998). Although there is no significant correlation, the responses show that now as adults, 29% of respondents are currently engaged in science-related careers with another 5% specifically in science teaching careers. If their perception is that their participation in SSWK changed their interests and attitudes toward science, then that is the reality for them and the reality under which they have lived their lives and responded to the survey questions. As shown in Table 15 and supporting previous studies, longevity in the club was indeed a good predictor of those entering science careers. This finding seems particularly interesting since many members claimed the science involved was remedial in nature and after three years, it would seem that members would have grown tired of the low level and sought membership in some of the more competitive science ECA which I sponsored. However, they stayed with the club because they just enjoyed science and anything associated with it. They enjoyed learning new things about science, were more apt to change squads and demonstrations, and more often than not, developed new demonstrations after consultation with me. Public school members were almost twice as likely as private school members to enter science-related careers, with 20% more non-Caucasians than Caucasians and with 33% more males than females entering science-related careers, this latter finding more in line with previous research studies.

If science career interest is dependent on the degree of student-centered instructional strategies (Grabowski & Darling, 2005) suggest, the highly interactive nature of SSWK should promote considerable interest in science careers. There is a close alignment of member groups who enjoyed hands-on science in Table 11 with those choosing science careers in Table 15. In fact, 27 (29%) respondents indicate that they are currently in a science-related career field (science, technology, engineering or medical) (see Table 2). Comments from those regarding science careers included these statements:

- I am not sure if my involvement in the club influenced my collegiate choice, but i did pursue Computer Science as a degree and practice it today. (41)
- I learned that i liked interacting with kids--now i'm a pediatrician! (90)
- As stated before, the experience had a larger effect on my college and professional career in that I have stayed in science (as a practicing engineer) and still enjoy coaching and mentoring our new staff members. (61)

- I think the club really raised my interest in science and helped me choose nursing as a career. (23)
- Working with the children in the elementary school was one of the factors that led me into teaching. (63)
- I was already set on a science path beforehand, though the club helped develop that interest. (65)
- It [SSWK] also helped me to excel in my (previous - before kids) profession of being a software developer. I am very proficient at coding, but I was called on regularly to go to the client to help wheedle out what the requirements were because I was technical enough to know what could be done, but people-oriented enough to get the thoughts and ideas across. (8)
- In my professional career, I work in desgining pharmaceuticals for cancer treatment. I use the same approach of science as being fun to explore in drug design sometimes it works, other times it does not. Being able to share with other the excitement of research in the lab and new techniques in current progress, is really no differenet then sharing science with kids.(just a different audience, with different intelectul capabilities) (49)

Businesses have strong expectations for those who work alongside scientists, in that these auxiliary people must be able to handle the science content as well. One such Whiz Kid in a science-related career offered this experience:

> Because science didn't come naturally for me, I focused most of my efforts in high school and college in other areas. . . .I worked professionally in the field of broadcast journalism before leaving for a career in pharmaceutical sales. As previously mentioned, Suzy Science reduced my fear of science and played a role in helping me to realize I could be successful in a field related to science even though it was a subject that didn't come naturally to me. During my first pharmaceutical sales interview, one of the interviewers expressed concern about my ability to grasp the science involved because I had left a career in journalism. While I didn't reference Suzy Science specifically in the interview, I confidently reassured him that it wouldn't be an issue. . . .Without my positive experience in Suzy Science, I may not have had the confidence necessary to tackle a career change to an industry so heavily focused in science. (62)

Career Aspirations in Teaching. Significant others, such as teachers can impact or enhance these trajectories of identification with expectations and values, just as I encouraged many of the Whiz Kids to apply their affinity for young children toward teaching careers (Van Bockern, Wenger & Ashworth, 2004). Former Whiz Kids described their career aspirations of going into the teaching profession. From the survey, 24 (26%) respondents indicate that they are currently in an educational career field with 5 (5%) going specifically into science teaching fields. Several (11 respondents, or 12%) are currently stay-at-home-moms, and some indicated that they are home-schooling as well. Several responses indicated that participation in SSWK led to or reinforced decisions to go into teaching. Table 15 shows that nearly 60% more public school members, female members, and Caucasian members were likely to go into teaching careers than their counterparts. Longevity once again showed a strong direct relationship with teaching careers with a slight drop of two-year members. Similar patterns of going into science teaching are also shown in Table 15. Non-Caucasian members and three-year members however, had no one engaged in science teaching, with the longevity pattern in complete reversal from those going into teaching. All three-year members went into science or education careers, but none went into science teaching. Some former members' responses regarding teaching are shown here:

- It was my first experience teaching. I throughly enjoyed going to the elementary classes and seeing the students learning something new. (9)
- It gave me the confidence to teach other children. Eventually I became an elem. school teacher, and this club helped pave the way for me to go into that career. (59)
- I am now a teacher myself, so I think Suzy Science was one of my first experiences in "teaching" others, which I obviously now love! (4)
- I became an elementary school teacher. I think that my participation in the club helped me to realize that I wanted to become a teacher because I enjoyed getting up in front of the kids and teaching them about science. (15)
- I went into teaching myself. Mrs. Kralina made learning fun, and I wanted to share that with others. (10)

- Well I am a teacher now. I have been pretty comfortable in front of a crowd discussing something. Fo4 5 years I worked for the Boy Scouts and would have to stand in front of people in the scout uniform and some would laugh at first but I didn't care because I have worn costumes before in front of crowds. I am a big goofball now in front of my classes. (29)
- Working with children is what I enjoyed the most. It gave me an opportunity to follow my dreams of being a teacher. (66)
- The club provided some foundational beliefs in teaching methods of elementary school science that started to be formed at this time and this was the real benefit to me. I can point to three or four points of reference for explaining my beliefs in teaching science to elementary students. Being involved in this club would be, chronologically, the first event I would point to. (2)
- I think this was the first step toward my professional goals of working at a history museum. It gave me the confidence to stand in front of a group of people and speak. That has greatly influenced me. (54)

Career Aspirations in Other Fields. The obvious aspirations toward science and education careers based on the club activities were anticipated and expected, but the impact SSWK had on the Whiz Kids' trajectories toward business-related careers was also interesting to discover. Based on survey data, 28 (30%) respondents are currently in a corporate or business-related career field. They recall the benefits of SSWK for their current occupations:

- It was great practice for delivering complex information -- teaching is an important part of what I do in the corporate world whether it's through change management strategy, explaining a difficult concept in a meeting, or delivering systems training in a formal classroom - my participation in the club helped me practice some of the techniques that I would later use in business (patience, communication with various groups, breaking concepts down into simple terms, building on past knowledge, etc.) (55)
- The club helped me with presentation skills (especially to different audiences) which is invaluable in the business world. (13)
- I don't use science too often in my field. Especially, basic scientific principals. However, I am ALWAYS giving presentations, speaking in front of large groups, running meetings, preparing information and conveying information to team members, etc. So, looking back on this. Knowingly/unknowingly at the time I was gaining confidence on how to present information to large groups. Gaining confidence and

> comfort of presenting to people and learing how to organize information and present the important facts. All of these have helped me in my career. (46)

SSWK experiences also helped those who went into law (5, or 5%): “I have cases involving forensic evidence, which requires a basic understanding of science, such as DNA, fingerprint comparison, drug weight and mixtures, drug field tests,and intoxication.” (20)

Career Aspirations: Clarification. Frequently in discussing career aspirations, emphasis is on choosing careers, but for some individuals, it is finding out what they don’t want to become. Trajectories for Whiz Kids seemed to have worked the same way. Learning what career that a person does not want to do is just as important as learning what a person does want to do:

- I remember being pretty shy in the face of the whole thing, and was surely less enthusiastic and engaging as some of the other Whiz Kids. It was a good experience dealing with the elementary school children, but I felt I wasn't quite cut out for it. (75)
- The impact in my case was a certainty that I did not want a job related to teaching science or anything else to elementary school age children. I did use the teaching skills I refined as an undergraduate lab TA. (91)

Career Aspirations: A Summary. From the survey data, there is a moderate, significant correlation between career aspirations and overall trajectory scores ($r = 0.449$, $\rho = 0.000$), meaning that those members who spoke of their career aspirations were somewhat more likely to be those who had voiced more changes in their trajectories, as measured by the indicated variables. However, there are several outliers to this finding, suggesting that other factors are impacting these results. Plotting career aspirations by school and new trajectory scores by school yield similar patterns between schools, but do not resolve the outlier inconsistencies of the career aspirations and new trajectories correlation. There are only weak correlations between career aspirations and overall ECA engagement, behavioral and cognitive engagement. There are several outliers in each correlation as expected with weak correlations.

Reflections. As the survey probed deeper and neared its end, survey respondents seemed to regress to the 'flow' or timelessness of being in SSWK and started 'thinking out loud.' They began interjecting their own thoughts and comments, irrespective of the questions asked. They had something to say about their experiences and if it wasn't asked, they simply added it to the current question before them. While reflections are not a part of changed trajectories, the recollections within them illuminate additional aspects of their involvement in SSWK. With the passage of time, these former Whiz Kids now have the affordance of hindsight and reflection regarding the perceived value and changes that occurred because of their participation in SSWK. Comments have been coded as reflections if they include present-day facts or relationships not possible at the time of their SSWK participation, i.e., "my children," "my wife," "my boss," etc. The number of reflections respondents offer may or may not indicate the relative importance of SSWK in their lives, but may indicate the importance individuals place on reflecting, or evaluating their experiences for their impact. As such, reflections are included in this section (NT).

As shown in Table 15, most members had considerable reflections to share. For some, the reflections are highly personal, in that several couples formed within the club and later married. Private school members tended to offer more reflections than public school members and Caucasian members made 10% more comments than non-Caucasian members. There was no difference in reflections based on gender with female and male members contributing reflections in equal proportions. Surprisingly, three-year members offered fewer reflections than those with less longevity. Reflections are grouped by topics, that is, personal growth, recommendations for SSWK club improvements, and current directions and emphasis of education.

Reflections: Personal Growth. Former Whiz Kids shared insightful reflections about the impact that their participation in SSWK meant to them personally, in supporting or extending their belief systems, in the way they currently communicate with people, and as they evaluate the current directions in education, particularly for their own children. They offered these reflections of personal growth. They are inspiring to read because they reflect the adults they have all become. This is what teaching is all about, training children in such a way that they become productive, caring, educated citizens. Their education levels are now very evident in their clear communications with very few spelling or grammatical errors, as opposed to previous comments as they reverted back to their high school days:

- I think being the leader in the group helped me in later organizations and as a result I tend to take on other leadership roles in other organizations. (36)
- It taught me that not all science is for brilliant minds and boring people. . . It was an honor to be part of something that transpired time. It was a worthy experience and I feel quite lucky to have been there in the beginning. (5)
- It helped me with my presentation skills and I married another member. (72)
- I had fun in high school, but wanted to move on and get to the working field. I just wanted to get on with life. [But] You would not believe the number of times I tell kids now a days how that $5 an hour I was making at the pizza restaurant was not worth what I gave up. I am sure I had great times in the club as well as high school. I just could/should have savored that moment a little longer. (56)
- I think involvement in clubs like this are essential in high school. It gave me the chance to work in an academic and group environment and insprire younger children to excel in academics. (17)

Some former members saw participation in SSWK as representative or an extension of previous attitudes or beliefs:

- Suzy Science was an addittional activity that suported a paths that I was already taking in my life. (64)
- I was already set on a science path beforehand, though the club helped develop that interest. (65)
- My participation in this club is fairly representative as to the way I have led my professional and personal life. Most of the time I am there to assist others. I highly doubt that my involvement in this club would have been the catalyst to this way of life for me. (55)
- Being in the club added to my already established interest in science. It made me consider possibly being a science teacher "when I grew up." (60)
- I already liked the subject, so I went in with a good attitude to begin with. (68)

They reflected on the impact of their participation in the club on the way they currently communicate with other people:

- Now, with my own children, I find that I want to help them learn the "hows" and "whys" when they are studying something involving science. I try to make what they are learning a little more fun and I think that in turn makes the concepts more readily understood. (35)
- I often find myself being questioned by friends and family about cancer treatments and methods, whom have little to no scientific background. Much the same as talking to scientific children, through demo experience I found it is much easier to relate concepts and drug interactions to them. (49)

Reflections: Recommendations. Their reflections often included recommendations on how SSWK could be improved. Public school members offered more suggestions than private school members. This might be expected since the club originated there and many respondents belonged during the initial development and refinement. Male members made more recommendations than female members, yet none of the respondents suggested changing the main character to a male. In fourteen years, I was only asked one time to consider changing the club, proposing it be called, “Sammy and Suzy Science and the Whiz Kids" and surprisingly, the rest of the members at the time discredited the idea because the name would be too long. Caucasian members made twice as many recommendations to help improve the club as non-Caucasian members. This may be due to some degree on different cultural upbringing regarding questioning or challenging adult decisions. Three-year members had the longest exposure to the program and offered nearly twice the number of recommendations as one-year members gave. They strongly encouraged more group exchanges and interactions.

Reflections: Current Direction of Education. Upon reflection of their experiences in high school, some former Whiz Kids pondered the current directions and emphasis in education today. They project hopes of similar science ECA for their own children:

- It made me realize how important science is to a kid's education. (73)
- As I said before, I think the overall benefit of the club is more toward the children than the high school students. I'm seeing more and more outreach to elementary school students from the science and engineering schools to gain interest country wide. It's apparent now that SSWK was maybe at the forefront of this. Getting children interested from a young age in science is a very good thing. (68)
- I don't believe it [SSWK] affected my attitude toward science, but it did affect, at least to some degree, my attitude toward the education of youth in society. I realized that the education of young people is not solely dependant on trained educators nor certified instructors. (52)
- From what I can remember, Suzy Science and the Whiz Kids was way ahead of its time. I don't remember ever learning science in elementary school in such a fun and engaging environment. I have four-year-old twins now, and I hope there is a program like this for them when they get to elementary school. Hopefully, they would also have the chance to participate in such a club in high school some day. I also fear the recent trend toward teaching to the test may not recognize the intrinsic value of a club like Suzy Science and the Whiz Kids both for the elementary kids and for the high school students. My boss tells me the best way to learn a subject is to present on it. Most of us, if we have to make a presentation on a topic, will do whatever it takes to learn everything we can about it. Suzy Science provided this opportunity for us in high school. (62)

- I was involved in a club that I hope my kids can be a part of some day or something similar. I got observe an amazing teacher and her love for teaching. I learned how to make presentations which I still do to this day. (3)
- I still remember my character's name, "Melanie Moo Moo." I wish this type of club were present in our schools today as science is being pushed back with the emphasis on reading & math achievement/test scores. I think NCLB may be leaving science behind. (60)
- There were a lot of pretty fun things that we did with the club and wish that they were still around today for the students in High School. They need something that can show them how science is fun and that there is a lot more to school. (29)

Reflections: A Summary. In all, respondents made 189 reflective comments (32% of all trajectory responses). From the survey data, there is a strong, significant correlation between reflections and overall trajectory scores ($r = 0.748$, $\rho = 0.000$), meaning that those who were more reflective in their responses were highly likely to be those who voiced more perceptions of changes in their trajectories of identification, either through future self-images, educational opportunities, or career aspirations. There are two minor outliers, representing two members who offered very few reflections considering their relatively high trajectory scores. The first member was simply very succinct in her reflections: "Here's the big lesson, as I see it: Effective communication whether in teaching or the business world depend upon 1. comprehensive understanding of your topic 2. thorough and creative preparation 3. enthusiasm. These three things I first began to learn in Science Club." (26) The second member offered few, but strong reflections that were more faith-based:

> Jesus very much used my participation in the club to increase my curiosity for the sciences, I never really saw before why science was so needfull, interesting, helpful, or how it could be fun, real. . . I thank the Lord, because I had not known that there was more/what more was out there. I had the opportunity in the club to explore things that I had never saw or knew before, be it my upbringing, or whatever, it helped to open a

> door. (76)

Thus, the data still tend to support the finding.

There is also a moderate, significant correlation between reflections and positioning ($r = 0.444$, $\rho = 0.000$), meaning that those who were more reflective in their responses were somewhat more likely to have voiced perceptions of more changes in their social positions. The two outliers in this correlation still offer support for this finding. These two members expressed several reflections and perceived changes in their positioning. One member addressed the correlation directly this way: "I am not afraid to talk in front of a group, and this club helped with that skill. In my professional life, I lead people who design and deliver training materials. I also measure the effectiveness of the training intervention. I think this club helped spark my interest in doing this type of work." (45) Having the highest positioning score, the second member spoke just as emphatically in his reflection:

> It reminded me that science doesn't have to be boring and can be approached in many fun ways. It reminded me that there are a lot of things out there that I don't fully understand, and that it's never too late (or early) to learn more about those things. Though traditional "science" was not a part of my college/graduate education, I still am fascinated by science-related topics in magazines or on television (astronomy, high-level discussions of particle physics, using chemistry to develop new and stronger materials for everyday life, understanding why the flu virus may be getting more immune to human attempts to avoid it, etc.) I would not be very good at inventing any of these things or be very happy researching the General Theory of Relativity all day in the workplace, but I still find such topics interesting. Suzy Science was one of many outlets for science in my background, and I'm sure it played some sort of role (exactly how large is unknown) in developing my interest in larger science-related issues. (22)

There are only weak correlations between reflections and overall engagement, cognitive and emotional engagement. As with weak correlations, there are several outliers that challenge these findings.

Impact on Personal/Professional Life. On the survey, respondents were asked to rank and describe the impact that SSWK has had on their professional and/or personal life, using a scale 1-5, where 1 means no effect at all and 5 means significant effect. Their responses are shown on Table 15. Groups show the same relatively high impact, with the lowest impact reported by non-Caucasian members, and the highest impact felt by three-year members. Public school members, female members, and Caucasian members reported a somewhat greater impact than their counterparts.

The impact of their participation can also be seen in the references these former members made to SSWK after completing high school. One (1%) respondent did not answer the question and 7 (8%) could not remember. Twenty-three (25%) said they made no later reference to the club, but 61 (65%) did make later references to the club and their role in it. While 14 (15%) used in on college applications and resumes, 46 (50%) respondents talked about it with many people. As shown in Table 15, longevity definitely impacted the number of references made about SSWK after high school. Public school members reported nearly twice the number of references as private school participants, signifying once again the importance of ECA for bonding and connectedness in larger schools. Female members made 36% more references to SSWK than male members did, with several females commenting on the leadership and initiative they learned as members. The surprising result was the different response rate between Caucasians and non-Caucasians, with non-Caucasians making 45% fewer references, despite the positive remarks from this group noted elsewhere on the survey. Longevity showed a characteristic exponential curve with the number of references made. Here are some representative reflections about belonging to SSWK:

- As you meet people in college and share your past experiences, many wondered what exactly a Suzy and the Whiz Kids group was all about. It was fun to explain what we did, as well as demonstrate experiments if possible. (23)
- I have talked about how the group worked and what we did. When I was in college, there were other students that would comment saying they wished they had the same opportunity. When I see a few of the others I worked with, it is brought up sometimes in conversation. (29)
- I have referred to the club many times. I have told my own children about the club. My daughter currently participates in "Mad Science Camp". I bring up Suzy Science all the time when I hear about what they have learned. I hope my son might find a club like Suzy Science when he starts high school. (35)
- I remember using my character name for a college activity. (60)
- I have many friends and relatives who are now teachers. I've often talked to them about my experiences both with the club and in Mrs. Kralina's science classes. (70)
- I remember telling my husband about it when we talked about our time in school. I've run into some of the other whiz kids and we'd reminisce about the fun we had and how much we enjoyed the chemistry class. (82)
- I referenced Suzy Science on my college applications, I talked to other members about it as well as new friends. When I told my husband about it he said, ‘That's awesome! I would have done that too!!’ (84)

One final note from a former Whiz Kid on how he referenced SSWK after high school:

> In college, we were discussing how different learning styles make it difficult for teachers at any level to connect with students. I referenced Suzy Science as one way of introducing younger students to topics that may be a bit dry for them or not have any direct relationship to what they do in their normal lives. Also, my mother was in a graduate-level class about learning styles and she also cited the program as a great example of how you can make difficult concepts understandable in a fun way to children (the class was part of a graduate degree in early-childhood education). And, of course, my friends and I have cited the club before at reunions and other events when we are remembering "fun" memories from {our school} days. (22)

SSWK Remnants. These former Whiz Kids have expanded and continue to expand their trajectories of identification through their future self-images, educational opportunities, career aspirations, and continued reflections. While "Brigadoon" exists only on an island in time, SSWK impacted these members during their high school career and now they have taken SSWK with them into the future. Although SSWK was a unique sponsor- and site-specific science ECA, its educational precepts have been promoted in several other venues by former club members and even by their parents. One former member became a chemistry teacher and started her own SSWK club. There are remnants of SSWK still alive today, as described in these comments. Some remnants are in educational settings:

- I held [*sic* - sponsored] the club myself knowing what it can offer both k-6 and highschool. (69)
- I have shared my experiences with my daughter who is now in high school chemistry. We've talked about starting up a club in her high school and have been exploring the necessary steps in making it happen. (52)
- I have mentioned it to my students when I teach. In fact, I have also recommended that our math club do something similar when I co-sponsored math club. (81)
- I have many friends and relatives who are now teachers. I've often talked to them about my experiences both with the club and in Mrs. Kralina's science classes. (70)
- The club had a very positive impact on my high school experience. To this day, it is one of the things I look favorably on. Unlike the vast array of awkward high school moments that I'd like to forget. In any case, all of these experiences shape who you are as a person. In fact, I recently used some of the things I learned in the club when I was demonstrating several science concepts to a group of Cub Scouts about 4th grade age. IE.) keep it simple, keep it fun, keep it moving, let them do it, etc. I probably would not have ever realized it if I had not been completing this survey but its true. (80)

Poignant memories spurred former Whiz Kids to take their learning into new situations and apply it in the business sector:

- I've used the lego experiment in my office retreats, to extraordinary reception .. the experiment where one person builds something out of

Legos and tries to explain how to build the same thing to their partner without visual aide. (41)

- I use it when I am training new trainers - I've had them do the static electricity skit in a Train the Trainer session that was geared towards helping them understand how to effectively present information that could be viewed as dry, and jazz it up into an interactive learning experience. My Train the Trainer session has also included the circuit trick to help the trainers learn how to effectively take something they didn't know before, learn it, and then turn around quickly and train it. (45)

Sometimes it has been their parents who have incorporated the ideas:

- My mom is an elementary school teacher who has built her entire career on outside-of-the-box thinking when it comes to transferring knowledge. The approach utilized by Suzy Science was right up her ally. (62)
- While their [my parents] initial take was probably like, "Umm, you are going to dress up like a clown and talk about science??", they quickly were able to understand why the project was set up as it was and the benefits of acting that way. The target for the presentations were young children, not adults. And what 3rd grader is going to care about the Scientific Method if you sit them down and walk them through it? Now, bring in costumes, a big bedsheet-sized target, and popcorn popping 6 feet into the air before falling back to the ground, now you have got something! In fact, my mother was a kindergarten teacher at the time and years after I graduated, she had to write a paper on great educational ideas she'd witnessed and the general concept of Suzy Science that her son had participated in at my school was one of her better examples of how to make something interesting for young students. (22)

Volunteerism

Participation in SSWK also seems to be equally effective in predicting future volunteer service (Fisher & Ackerman, 1998; Hanks, 1981; Hanks & Eckland, 1978; Janoski, Musick & Wilson, 1998; Regnier & Planty, 2003). Survey respondents were asked to describe any current volunteer work in which they are engaged (see Table 17). The current volunteer efforts by former Whiz Kids occur between ten to twenty-five years after their participation in SSWK. Six respondents (7%) did not answer the question and

18 respondents (20%) admitted that they are not involved in community service or volunteer work of any kind at this time. However, an impressive 73% of the respondents indicated that they are actively involved in one or more volunteer organizations within their communities. Once again, because of the focus of this study, volunteer work has been categorized with respect to education/children-related and science-related organizations. Of those who are volunteers, 20 respondents (29%) are involved in some form of educational volunteer work, 13 respondents (19%) are involved in volunteer work in a scientific venue, and 17 respondents (25%) are involved in a form of volunteer work that does not have children or science as its emphasis. Thirty-one of these former members (46%) are involved in a combination of educational, science-related, and other volunteer efforts.

Table 17. Volunteer Efforts of Survey Respondents

Volunteer Efforts	No. of Respondents	Percent Respondents
Science/Education Combination	31	46
Education-related	20	26
Science-related	13	19
Non Science/Education	17	25
Currently not a volunteer	18	20
Did not respond	6	7

Data analysis shows correlations, albeit weak but significant, between volunteerism and overall ECA engagement, behavioral engagement, emotional engagement, social positioning, and trajectories of identification. As shown in Table 14, public school members are over 40% more likely to be volunteers than private school members, while female members and Caucasian members are over 10% more likely to volunteer than male members and non-Caucasian members. One-year and three-year members were 10-20% more likely to volunteer than two-year members. One respondent realized she wanted to do more volunteer work while still in SSWK: "In addition to the science component, it [SSWK] expanded my desire/ acknowledgement of volunteerism." (76) One former Whiz Kid explained the importance of volunteer opportunities this way:

> There is also something to be said for presenting high school students with an opportunity to get beyond themselves and to focus on the needs of others. Suzy Science provided this opportunity. Typically self-absorbed teenagers were actually, even if it was for just a few hours, more interested in bringing someone else joy. This alone in my opinion far outweighs any potential negatives associated with high school students missing a few hours of classroom time. (62)

The organizations named cover a vast array of topics, interests, and administrative levels; from education to science and technology, from religious and charitable to civic service, from local to national levels. Positions within these organizations range from leadership roles to general volunteers. Looking over this list depicting their countless hours of service for the betterment of their communities and nation, I am in awe at the extent of their willingness to help others. These are truly the responsible, productive citizens that our schools are expected to educate. I am honored to have known all of these dedicated individuals.

Their organizations include a national youth leadership program for high school sophomores, Girl Scouts, Boy Scouts, Big Brothers/Big Sisters, 4-H Equine Division, US Peace Corps, Mother of Twins, Mother to Mother support groups, Junior League, Little Bit Foundation, Environmental Education Centre, Kidsmart, Banned in Boston for

UrbanImprov, city review board for development, Governor's Organ Donation Advisory Committee, Knights of Columbus, Leukemia and Lymphoma Society, National Animal Health Emergency Response Team Hurricane Animal Relief, American Heart Association Heart Walk, Susan G Komen Walk, Special Olympics, children's hospitals, History and Art Museums, Foundation and Scholarship Boards, Women of Today, county youth fair boards, local and inner-city school districts, universities, nursing homes, rescue missions and food pantries, nuclear reactors, science clubs, animal shelters, youth sports teams, "Kairos" (spiritual retreat for prison inmates), Red Cross, radio stations, and various charities.

Volunteer leadership roles include Scout troop leaders, treasurers, deaf interpreters, webmasters, school supplies Chair, math/reading tutors/mentors, A+ advisory board members, coaches, substitute nurses, teacher aides, room moms, planning committee chair, fund-raising chairs, fire department EMT, university EMT, CPR and first aid instructor, county and state emergency manager, financial counselor for the needy, English teacher in a small village in Kazakhstan, nuclear science merit badge leader, tour guides, club sponsors, museum docents, newsletter editors, organ donor administrators, District Deputy and a Grand Knight.

Positions in religious affiliations include Evening and Altar Guild members, ushers, church choir members, Sunday School teachers, network engineers, spiritual retreat leaders, nursery workers, and children's program leaders.

Trajectories of Identification in SSWK: A Summary

New social positions modify and expand trajectories of identification. Changes in these resulting trajectories and their interaction patterns is evidenced in more diverse future self-images (NTF), expanded educational opportunities (NTE) with applications and resumes (NTA), and enhanced career aspirations (NTC). Career aspirations have expanded to include more science-related careers, teaching among others. In some instances, learning what careers are not a good match is equally significant. Former members became reflective in their responses and offered comments of personal growth, recommendations for SSWK club improvements, and concerns with the current directions and emphasis in education. Participants described the impact of SSWK on their personal and professional lives, sharing how remnants of SSWK are still alive today. If ECA participation fosters adult volunteerism, these participants give exemplary proof with their impressive list of volunteer efforts.

Trajectories of Identification in SSWK: Regression Analysis

There were 588 comments coded as new trajectories responses (48% of all identity formation coded responses. In general, overall trajectory scores show a moderate, significant correlation to positioning scores ($r = 0.537$, $\rho = 0.000$), meaning that those former members who perceived/ expressed more changes in trajectories of identification were somewhat more likely to those members who perceived more change in their social positioning. The one outlier is the member (22) who has been cited previously for his high positioning score as well as many reflective comments regarding growth and development.

In addition, overall trajectory scores show correlation to several engagement variables. There is a moderate, significant correlation to overall ECA engagement ($r = 0.476$, $\rho = 0.000$), meaning that those former members who perceived more changes in trajectories of identification were somewhat more likely to those who were overall more actively engaged in the club. There are no outlier data to refute this finding.

Table 18. Summary of All Trajectory Responses

Coding	NTA	NTC	NTE	NTF	NTR
Variables	Applications, resumes	Career Aspirations	Educational Opportunities	Future self-image	Reflections
Total # of Responses	32	106	100	161	189
Percent of Responses	5	18	17	27	32

Overall trajectory scores also show a moderate, significant correlation to cognitive engagement ($r = 0.519$, $\rho = 0.000$), meaning that those former members who perceived more changes in trajectories of identification were somewhat more likely to be those members who were more cognitively engaged in the club. There are no outlier data points to refute this finding, either. Trajectory scores also show a moderate, significant correlation to the impact of costumes ($r = 0.527$, $\rho = 0.000$), which means that former members who perceived more changes in trajectories of identification were somewhat more likely to those members who more clearly understood the impact of costumes on their performances given to elementary school children.

A multiple regression analysis was used for overall identity formation scores and trajectories of identification as measured by future self-images, educational opportunities, applications and career aspirations, and reflections, that yields $F_{(5, 91)} = 40.963$, $\rho = 0.000$, reiterating this strong correlation ($r = 0.839$). After correcting for interaction effects ($r^2_{adj} = 0.704$), this analysis shows that 68.7% of the variance in overall identity formation scores can be explained by these five trajectory variables.

Limitations to Identity Formation in SSWK

Limitations for this section of the study include the use of self-ratings, multiple variables impacting the results, question composition, timing, and the close etic perspective of this researcher. Self-ratings always have an enhanced value (Xie, Mahoney & Cairns, 1999). Multiple variables impact the formation of identity and may not be isolated completely for analysis. In a similar manner, time and experiences between their actual participation and the current study may have impacted the memories, perceptions or realities of the former members. One member even offered this apology:

> I did have a great time and enjoyed great relationships. I'm very glad that I was able to participate. I wish I could remember more from those days. After high school, during my college years, I was pretty sick with a terrible heart arrhythmia. It got worse and worse for a few years. In {date}, things got really bad and I wound up in the hospital for a while, eventually having surgery to correct things. Unfortunately, one of the ugly side affects of all that was I "lost" much of my memory of things before {date}. I know it sounds unusual, and there is more to the story that I can't go into here. But, hopefully what little I can remember can help with this research project. (24)

Limitations may have also included the question composition or delivery. Survey and interview questions may not have been specific enough for respondents to completely understand the topic being discussed or the questions did not directly address the concept to be investigated. The etic perspective of this researcher influences the interpretations of the responses, the results, and the choices of responses cited, as discussed earlier, although efforts have been made to insure that all voices were heard and none dominated the report.

Summary of Identity Formation in SSWK

These former Whiz Kids experienced changes in their social positions by 1) wearing costumes whether for attention, ease in relating to others, role-play, masks to hide their identity, or new identities to assume; 2) engaging in new actions that led to learning new things, experiencing new ideas, or applying knowledge in new situations; 3) viewing things from different perspectives, such as those of children, teachers, performers or outsiders; and 4) embracing teamwork as a community. These former Whiz Kids described new identities that developed with increases in personal growth, circles of friends, presentations and leadership skills, teaching experiences and science expertise. Vygotsky (1978) attributes such increases to socially distributed cognition, or the social interaction with more capable peers, a process also affirmed by Scardamalia, Bereiter, and Lamon (1994). Perhaps the interactions, freedom matched with responsibility, and sense of community within SSWK had expanded their zones of proximal development, allowing each member to reach higher levels of development within these special groups of more capable peers. These new social positions led to new or expanded trajectories of identification in terms of future self-images, educational opportunities and career aspirations in science, teaching and other professions. Their reflections depict the impact that their high school participation in SSWK has had on their personal and professional lives, communication with others, the value they place on education, and particularly their current volunteer service to their communities.

Summary of Results

Former members are now adults and have responded to an online survey regarding their participation and involvement in an ECA high school science club called

"Suzy Science and the Whiz Kids©." Their participation occurred 10-25 years ago. Each response was coded, based on the coding schema discussed previously. An overall engagement score was calculated for each participant based the algebraic sum of their scores for each engagement component. Similarly, an overall identity formation score was determined for each respondent based on their scores on positioning and trajectories.

A strong, significant correlation ($r = 0.671$, $\rho = 0.000$) exists between overall ECA engagement and positioning, meaning that those members who were more actively engaged in the club activities were more likely to be those who perceived more changes in their social positioning. There are no outliers in the data to refute this finding. An equally strong, significant correlation ($r = 0.646$, $\rho = 0.000$) is found between cognitive engagement and positioning, meaning that those members who were more cognitively engaged in the club were also more likely to be those who perceived more changes in their social positioning. This pattern is tested against the two minor outliers in the data. The first outlier has been cited previously as a former Suzy Science who scored high on positioning but tended to focus on the more creative aspect of the club rather than the cognitive aspect: "I found it [science] easier to understand and much more fun. It was a creative turn to the problems at hand and allowed for a much different perspective." (30) The second outlier also scored high on positioning but many of her cognitive comments and details were embedded in emotional language that may have impacted the coding, as shown in this response: "I also loved demonstrating my chemical change to the grade schoolers. They were fascinated with how the calcium fizzed and made the test tube warm." (35) Thus, the data still tend to support the finding.

A moderate, significant correlation exists between behavioral engagement and positioning (r = 0.429, ρ = 0.000), meaning that those members who were more behaviorally engaged in the club were also somewhat more likely to be those who perceived more changes in their social positioning. There is one outlier for behavioral engagement, representing one of the original Suzy Science (5) identified earlier for having the highest behavioral engagement score and while assisting many other members with routines and procedures, still showed increases in social positioning. Thus the data still support the finding. A moderate, significant correlation also exists between emotional engagement and positioning (r = 0.516, ρ = 0.000), meaning that those members who were more emotionally engaged in the club were also somewhat more

Table 19. Summary of All Coded Response Composites

Coding	Engagement			Identity	
	BE	CE	EE	NP	NT
Variables	BE Composite	CE Composite	EE Composite	NP Composite	NT Composite
Total # of Responses	897	535	1237	647	588
Percent of Responses	34	20	46	52	48

likely to be those who perceived more changes in their social positioning. There are three outliers for emotional engagement, representing three members who had very high emotional engagement scores in proportion to their positioning scores. The high emotional nature of the first member (7) as cited previously centered around her strong love of working with children with early initial leanings toward teaching. The second outlier, one of the younger former member displayed her enthusiastic, effervescent nature in all her responses, such as this one: “Our teacher, Mrs. Kralina! I loved her! I also liked getting out of school, what high school kid woudn't like that! I also liked my cool costume. It really was cool.” (3) The third outlier is a member who stressed how much he enjoyed being in the club and getting out of school:

> We laughed a lot. We had a good time and enjoyed each other's company. The club was a good way to get me out of the general high school population and spend more time with my real friends that I didn't see that much during the day. This club was one of the few bright lights in my overall terrible high school experience. (24)

Thus, the data still tend to support the finding.

Based on the overall scores, the survey components for engagement and positioning were then compared, as shown in Table 13. Behavioral engagement is abbreviated BE, cognitive engagement is abbreviated CE, and emotional engagement is abbreviated EE. New positioning is abbreviated NP and new trajectories is abbreviated NT. All the correlations discussed previously are summarized again in light of the various proportions of responses given. Weak correlations are not included here.

Behavioral engagement (BE) responses constituted 34 % of survey engagement responses and show a strong correlation to overall ECA engagement. There are seven BE variables. BE shows strong correlations with club routines and training and moderate correlations with leadership positions (squad leaders and Suzy Science combined), persistence (longevity), working together, as well as attendance and involvement.

Cognitive engagement (CE) responses constitute only 20 % of all survey engagement responses (a little more than half of the BE responses and only 1/5 of all engagement responses), yet also show a strong correlation to overall ECA engagement.

There are six CE variables. Despite receiving the fewest number of responses, the extent of the correlations for cognitive engagement is surprising. CE shows a very strong correlation with valuable learning experiences, a strong correlation with persistence of efforts toward goals, and moderate correlations with challenging situations and skills mastery. Other aspects of the club that are moderately correlated to CE include impact on science knowledge, making changes to individual demonstrations and squad presentation improvements. CE also shows moderate correlations with BE and EE as well as with club routines (BEW) and wearing costumes (EEW).

Emotional engagement (EE) responses constitute 46 %, nearly half of all survey engagement responses and show the highest and a very strong, significant correlation to overall ECA engagement. EE shows moderate correlations with CE, but little or no correlation with BE. There are eleven EE variables. EE shows moderate correlations with six of the variables, namely, working with children, emotional responses about the club, interests in science, new peers, ties to the school, and wearing costumes. EE is moderately correlated to other club aspects, namely, club training, impact on overall high school experience, and success in engaging children during presentations.

Overall ECA engagement scores show very strong correlations with EE, strong correlations with BE and CE and with club training. There are also moderate correlations with club routines, working together, challenging situations, valuable learning experiences, mastery of skills, persistence of efforts toward goals, working with children, emotional responses about the club, interests in science, new peers, making changes to individual demonstrations as well as squad presentation improvements, wearing costumes, and success in and evidence of engaging children during presentations.

New social positioning (NP) shows strong correlations with CE and overall ECA engagement and moderate correlations with BE and EE. NP shows very strong correlations with new perspectives, strong correlations with new actions, teamwork and identities, with only moderate correlations for costumes. There are also moderate correlations with other aspects of SSWK, e.g., working together, challenging situations, valuable learning experiences, persistence of efforts toward goals, new peers, making changes to individual demonstrations, and evidence of engaging children.

Trajectories of identification (NT) show moderate correlations with overall ECA engagement scores, CE and NP. NT shows strong correlations with educational opportunities and reflections as well as moderate correlations with future self-images and

Table 20. Summary of Correlations for Engagement and Identity

	Engage-ment Composite					
BE Composite	0.721	BE Composite				
	0.000					
CE Composite	0.760	0.445	CE Composite			
	0.000	0.000				
EE Composite	0.848		0.439	EE Composite		
	0.000		0.000			
NP Composite	0.671	0.429	0.646	0.516	NP Composite	
	0.000	0.000	0.000	0.000		
NT Composite	0.476		0.519		0.537	NT Composite
	0.000		0.000		0.000	

Top # = Correlation
Bottom # = Significance
Very Strong
Strong
Moderate
Weak (no entry)

career aspirations, but no correlation between NT and applications and resumes. Other aspects of the club are also correlated to NT, namely, valuable learning experiences, mastery of skills, new actions, costumes for fun and identity, and new points of view.

While the entire correlations table is too large to be included in this report, a brief correlation summary of the five major components is shown in Table 20. From these correlations and connections, a theoretical framework for an effective ECA can now be constructed.

Chapter Five: Discussion

An ECA Framework Based on a Review of Related Literature

Some of the major concerns within science education today deal with the decreasing engagement of students in scientific endeavors or pursuits, reduced levels of hands-on experimentation in science instruction except for science fair competitions, declining numbers of females entering scientific fields, and fewer individuals choosing to enter a science teaching profession. These areas of concern can be addressed and science education can be enhanced when learning is viewed as a continuum of experiences from formal classroom instruction to informal extracurricular activities, such as science clubs. To improve student learning, educators need to increase student engagement. Most studies use the term, *engagement* with a variety of meanings while this study examines engagement according to a three-component definition developed by Fredricks, Blumenfeld, and Paris (2004). According to them, educators need to better understand how students behave, think and feel. Their definition clarifies that effective ECA should engage students three ways, namely, behaviorally, cognitively and emotionally.

First of all, an effective ECA should cultivate those observable behaviors in students that promote gains in psychological adjustment, healthy lifestyles, and life skills for the real world and result in a decrease in problem behaviors. Behavioral engagement (BE) is defined here as attending ECA functions regularly, volunteering time and effort persistently (longevity), knowing/complying with the ECA routines, working with the teacher/sponsor/group to complete tasks, leading and making contributions to the group.

Secondly, an effective ECA should build on the deliberate cognitive processes, or the thoughtfulness and willingness of students to exert the effort necessary to comprehend complex ideas and master difficult skills, leading to increased academic achievement. Evidences of cognitive engagement (CE) are intentional decisions to join and participate, conscious efforts to train and master skills and challenging situations.

Thirdly, an effective ECA should foster the growth of emotional expression and social connection to develop interpersonal skills, social networks and positive attitudes. Emotional engagement (EE) is evidenced as positive or negative reactions, responses or attitudes toward peers, parents, and teachers as well as interests, concepts and school ties.

In addition, an engaging and socially constructive ECA includes the concept of social positioning that affects how students behave, think and feel. Social positions are based on interactions first with parents, then in schools and with peers that result in successively more constrictive social boundaries for interactions and growth. Education plays an important role in expanding these positions and boundaries. New social positions (NP) change subsequent acceptable actions, identities that can be assumed, perspectives, and peer interactions.

Finally, each step along the identity formation trail changes the resulting trajectory of identification and the subsequent way individuals react and interact with their environment. (Lemke, 2000). These changes to new trajectories (NT) alter future self-images, educational opportunities, career aspirations, applications and resumes, volunteer efforts as well as personal reflections.

Based on the review of the related literature, a theoretical framework for an ECA would be heavily geared to engagement studies. A theoretical model would include all three engagement components. However, studies generally investigated individual or unclassified components so relative importance or percentage of the three engagement components within a single framework has not yet been formulated. A number of studies made recommendations of essential characteristics for effective ECA, which a researcher could then categorize as to which type of engagement component it emulated and determine some proportionality in that manner, although this has not be done.

While the identity formation studies carefully delineated the identity formation process and documented resultant trajectories of identification, there were few, if any, studies that offered guidelines or suggestions on how to design an ECA that could change the social positioning among peer groups. In fact, most ECA studied established the social positioning ascribed to its members, e.g., jocks (sports), nerds (chess, science clubs), etc. A theoretical framework for an ECA based on the identity literature would have education as its core activity, though, to help students understand how they are positioned by others and by themselves. No specific recommendations of actions, activities, or behaviors were indicated for a socially constructive ECA, although studies promoted general processes, such as role-playing, helping others, building personality traits, and making connections to the community. There were no studies that posed a model grounded in the composite results of engagement and identity formation studies.

A Retrospective Study of Suzy Science and the Whiz Kids©

This study investigated five components for a science ECA by surveying and interviewing former SSWK members 10-25 years after their participation. Although these events occurred over a generation ago and regardless of technological advances, the cognitive and emotional needs of today's teenagers are still the same. Study participants approximate club composition based on school, gender, race and longevity. Perceptions stated by these adult former members may differ from the perceptions they would have voiced as teenagers. What they value now may not be what they valued then as members of the club. Not all members will have had the same experiences in the club, even if they were members during the same school year. Not all important memories may have surface, this study is limited to the responses from these participants, and once again, a frequency count is not intended to convey higher importance, just higher rate of occurrence. Members' perceptions represent reality to them now about what they think occurred in their past and, as such, these perceptions form the basis for their subsequent actions and responses. The composite of their recollections and perceptions allows the reconstruction of the reality known as SSWK years ago. Visiting with former students has been like finding "Brigadoon" in the mists of time. Conversations flowed easily, simply picked up where they had left off years ago.

The collective insights gleaned from these former members unpack the essential elements of what it meant to be a member of a science ECA and along with the review of the related literature are used to construct a theoretical framework for organizing an engaging and socially constructive science ECA. Designing a theoretical framework is like performing a fractional distillation, separating and identifying each element from the collection. These fractions represent those essential elements that are provided by the ECA and by its members; secondary elements are the results or by-products of the essential elements and are generalizable for any ECA. Then there are those components unique to one specific ECA, and those elements that are nonessential. This separation process distills the findings of this study as the discussion analyzes the various components with the resultant products or distillates revealed at the conclusion.

Unpacking the Essential Elements of Engagement

Behavioral Engagement (BE)

This study defined and investigated seven variables of behavioral engagement (BE), namely, (1) attendance and involvement (BEA), (2) leadership (BEL), (3) leadership by others (BEO), (4) persistence (BEP), (5) routines and expectations (BER), (6) interactions with the teacher (BET), and (7) working with others (BEW). Behavioral engagement (BE) responses constituted 34 % of all survey engagement responses and revealed several correlations with the other variables examined in this study. The previous chapter showed close comparisons and support as well as contradictions between SSWK and the literature reviewed.

Gender and Science Participation. The most significant comparisons in BE to the studies cited in the literature review are the contradictions on the issue of gender and participation in science ECA. SSWK membership averaged a gender ratio of 2:1, or 67% females to 33% males, contrary to some findings (Olszewski-Kubilius & Seon-Young, 2004). Females actively participated in SSWK in which each squad focused on a central physical science topic. The concept of females choosing to participate and enjoying physical science topics in science contradicts much of the literature (Bell, 2003; Howes, 2002; Kahle, Matyas & Cho, 1985). By their continued participation in SSWK and their survey comments, female members affirmed their interest and abilities in physical science topics within SSWK.

Time. Major findings dealing with behavioral engagement in SSWK converged on issues of time, leadership, interactions, and routines and expectations. The first consideration is time to participate in ECA. Behavioral engagement deals with the behaviors or actions that are indicative of the time and effort members invested in ECA. However, members with higher BE were not necessarily those who reported spending greater amounts of time in SSWK activities. This finding appears to be due to some confusion with the survey question on time spent in the club as discussed previously and the fact that more than a third of the respondents (39%) reported guessing or could not remember how much time they spent in the club, which altered the findings. Members with higher BE were likely to rate themselves higher on organization and efficiency, perhaps indicating that students who are more organized and efficient are better able to manage time and studies so they can participate in ECA.

Comments from members also tend to indicate that higher-ability students are likely to be involved in a variety of ECA (McNeal, 1998; Posner & Vandell, 1999). A higher percentage of students participated in SSWK at the private upper socio-economic high school (~ 6%), (where after-school sports participation was required for every student) than at the larger middle/lower socio-economic public high school (~ 1%), contrary to some studies (McNeal, 1998). Members at both schools were also behaviorally persistent, investing time over multiple years, perhaps indicating a higher level of participation depicting dedication to the club, with the exploration of dedication and engagement factors possibly involving a future study.

The amount of time spent in this club compared to other ECA produced interesting findings. Respondents indicated that time spent for SSWK membership did not demand exclusive participation or limit them from exploring interests in other ECA. Former members reported that typically the time invested in SSWK was much less than in other ECA. Some respondents, mostly females, reported that they spent more time in sports than in SSWK and/or that sports interfered with their participation in SSWK. Excessive time commitments in sports seem to prevent students from being able to participate in a greater variety of ECA, affecting possible developmental potentials. However, consideration should be made in the ECA design regarding the time commitments expected by members in an ECA in order to allow time for other ECA as well as academic studies.

Leadership Opportunities. Closely related to time investments, leadership opportunities (BEL) are also an important facet of effective ECA (Dewey, 1916). Females and males in SSWK assumed leadership roles as squad leaders in a ratio of 2:1, or in the same ratio as the club composition. Some Whiz Kids were long-time members, but were not leaders, due to the low turnover rates of squad leaders from year to year.

More studies in ECA need to address leadership positions. Contradictory findings assert that ECA participation appears gender-dependent. Some maintain that females are more likely to participate in ECA (Hossler & Stage, 1992; McNeal, 1998; Posner & Vandell, 1999) while others assert that males are more likely to participate in ECA although females participate in a greater variety of ECA (Darling, Caldwell & Smith, 2005; Simpkins, Ripke, Huston & Eccles, 2005). Perhaps these contradictory findings are related to time commitments, particularly for those members in leadership roles. If leadership positions involve considerable investments of time, this might prevent leaders in one ECA from participating in as great a variety of ECA as general members who are not in leadership positions and their corresponding time commitments. It may be that females have the time and can participate in a greater variety of ECA because fewer females are in leadership positions.

In SSWK, the reverse may have been true. The club composition was 2:1, females to males and leadership positions were filled in the same proportion. Females who had no leadership in other ECA would be able to invest the time for leadership in SSWK. However, leaders in SSWK (a low-time-commitment ECA, according to survey and interview responses) still reported being active in several other ECA. Fewer males participated in SSWK and thus, held fewer leadership roles in SSWK. Perhaps this was because they were heavily involved in other more time-intensive ECA and as leaders, such as Turban Tom, student theater director (71) or Billy Basketball (62) and Freddie Football (1), who left SSWK after one year to take on leadership roles in a sports ECA. Leadership roles may be more directly related to total time commitments and gender bias.

Effective student leaders in SSWK appear to have been more democratic than authoritarian in their leadership style. Participants stated that they appreciated the leadership opportunities they had while others revealed that Whiz Kids took turns being the leader or that no one was the leader within their squads during their school visits.

- We worked well together, and nobody seemed to be bossy or felt the need to be the leader and criticize. (92)
- My squad worked really well together. We experimented with different leaders with different ideas. I think that that helped us be a good group so that we could provide each other feedback on each other. (81)

More importantly, all the Whiz Kids were leaders in some respect for the young elementary school children as they gave their demonstrations. They all knew more that the elementary school children and this put them all in a position to be a leader. Due to the high expectations for squad leaders to maintain the communications network across a quarter-mile campus, I always asked select members to serve as squad leaders, those whom I felt I could trust with the responsibility. Allowing members to select the leaders from among their peers may have enhanced the leadership positions within the club or caused chaos based on popularity votes instead of dedication to the club. Leadership options appear to be an attractive component, but depending on the extent of the cooperative group work and other organizational features, they may not be an essential element of an engaging science ECA. There will probably always be some opportunity for leadership in ECA in a structured, responsible position in terms of records, membership communications and networking

Interactions. In addition to time investments and leadership opportunities, consideration was also given to interactions as a possible component for an engaging science ECA. Former members frequently commented on working well together (99 references), building a sense of teamwork and community (Csikzentmihalyi, 1999). Members working well together (BEW) experienced greater squad cooperation. Nearly half the respondents described helping each other learn the demonstrations and techniques. Younger members received help and guidance about the club's activities from more experienced members and interactions with the teacher (BET), reinforcing the concept of socially distributed cognition, or the social interaction and better learning with more capable peers (Vygotsky, 1978; Scardamalia, Bereiter & Lamon, 1994). The social interactions and communications in SSWK suggest a unique zone of proximal development (Vygotsky, 1978) that supports the high levels of squad cooperation noted.

Several studies noted earlier stress the importance of the teacher interactions (BET). Despite the lack of any questions on the survey regarding interactions with the teacher/ sponsor, 75% of the respondents indicated that the teacher was influential in their participation in the club and 59% commented on individual relationships with the teacher. The club structure mandated individual squad meeting with the sponsor to practice demonstrations and routines. These small group interactions laid important frameworks for personal relationships with the teacher (Broh, 2002; Csikzentmihalyi, 1999; Darling, Caldwell & Smith, 2005; Holloway, 2002; Kahle, 1983 McLaughlin & Irby, 1994; Mahoney 2000). Thus, cooperative interactions with peers and teacher seem to be an essential element for an engaging science ECA.

Routines and Expectations. In addition to time investments, leadership opportunities and interactions, the final consideration of an essential element was routines and expectations (BER). In contrast, if their friends are there and if they like what they are doing, members will be there and bring their friends (Kao, 2000). However, the structure for the ECA must be in place (Mahoney, 2000). SSWK club goals were explicit and were coupled with safe environment, challenging activities, flexibility, communication skills, meaningful goals, and caring leaders (McLaughlin & Irby, 1994).

Now as adults, former Whiz Kids reflected on their own perceived growth and development that took place during their participation in SSWK. They came to the realization that they liked learning new things, even complicated concepts; they enjoyed working in a science-related activity and had fun while doing inspiring work; they felt valued and trusted as if they were adults; and they enjoyed teaching the elementary school children. They perceived the club activities as rewarding or worthwhile. These same benefits are also cited in many studies (Barber, Eccles & Stone, 2001; Fredricks & Eccles, 2006; Harrison & Narayan, 2003; McLaughlin & Irby, 1994; Silliker & Quirk, 1997). The data also support the positive adjustments for non-sport ECA findings (Darling, Caldwell & Smith, 2005).

Routines and expectations (BER) received 42% of all BE responses, but this signifies only that the former members knew the routines. In their survey responses, 23% of the members offered recommendations on how to improve the club (see Table 15). Routines in SSWK also varied, based on the particular composition of the club membership each year. This variation offered flexibility and member ownership of the routines. Members developed their own special routines; e.g., building pyramids, making sweatshirts, selling Eggs-perigrams, designing festivals, etc. Every year, routines varied, but the goals of the club to share hands-on science with children by costumed members organized in topical squads were always the same. In addition to school visits, some years members accepted invitations to present at science nights, banquets, shopping mall and Science Center presentations; other years they accepted invitations for Girl Scout badge work, award nights, festivals, and PTA meetings, but the goals of the club were always the same. Some years they ate tacos, other years they ate pizza. Thus, routines and expectations offer helpful guidelines for club activities and appear to be a subset of club activities, but may not be an essential element of an engaging science ECA.

BE Summary. In summary, by examining the data collected from former SSWK members with respect to the seven BE factors, the essential elements among the BE variables from a qualitative viewpoint appear to be the cooperative interactions with peers (BEW) and teacher (BET), with considerations regarding time, leadership (BEL) and routines and expectations (BER). Cooperative, synergistic interactions with peers and the teacher align with the notion of social learning with more capable peers in individual ZPDs (Vygotsky, 1978). Time considerations include time to belong, time to lead, time to work with others, or time in the school year. Leadership opportunities

(BEL) vary based on the level of cooperation among squad members and may just become connection points to facilitate the social network. Routines and expectations (BER) support the club activities in providing procedures and in avoiding demands that become over-whelming or daunting. Members' time is not a design element in that an ECA does not/cannot arrange the *time* for members to belong; members themselves must invest their time to participate in ECA. However, an engaging science ECA should offer the least restrictive time factors, that is, reasonable time frames for activities and flexible scheduling to meet members' needs and to allow members time for participating, leading, belonging, as well as for studies, sports and other ECA so students can more fully develop their potentials. Thus, the essential elements of behavioral engagement proposed for a theoretical framework for an engaging and social constructive science ECA qualitatively distill to include interactions with peers (BEW) and teacher (BET).

BE Future Studies. Additional topics regarding behavioral engagement for future studies include, but are not limited to: fluctuating time schedules versus weekly meetings; engagement of students versus experience and qualifications of science ECA sponsors; time commitment for sports versus exploring potentials through greater variety of ECA; engagement versus dedication; leadership versus time commitments and gender; and leadership opportunities versus cooperative, collaborative working groups. Further investigations may investigate ECA participation versus timing in the school year; practice effect of repetitions for a spiraling curriculum; and ECA participation and educational TV watching.

Cognitive Engagement (CE)

This study has investigated six variables of cognitive engagement (CE), namely, (1) challenges (CEC), (2) valuable learning experiences (CEE), (3) life goals (CEL), (4) skill mastery (CEM), (5) persistence (CEP), and (6) reasons for joining (CER). Cognitive engagement responses constitute only 20 % of all survey engagement responses (a little more than half of the number of BE responses). Despite receiving the fewest number of engagement responses, cognitive engagement shows extensive correlations and some notable support and contradictions to the related literature.

Reasons. The most significant contradiction to the studies cited in the literature review for cognitive engagement deal with the reasons (CER) or intentional choices by high school students to join a science ECA. The number one reason cited by former members (34%) for joining SSWK is that the club sounded like fun, in complete contradiction to some findings (Shannon, 2006). Intentional choices centering on personal interests, i.e., interest in science (33%) and working with children, (32%) were the next most frequently cited reasons for joining club (Eylon, Hofstein, Maoz & Rishpon, 1985). However, not a single respondent (0%) specified 'meeting my needs' as a reason for joining the club. Nor did they list reasons such as seeking a challenge beyond their classroom studies (0%), preparing for a career (0%), or learning time management skills (0%) to help them in their classes, as suggested by other researchers (Olszewski-Kubilius & Seon-Young, 2004). Most importantly, none of the respondents (0%) indicated that they joined because of teacher coercion, course requirements, or because their parents made them, as suggested in some studies (Abernathy & Vineyard, 2001; Baker & Leary, 2003; Eylon, et al, 1985).

Perhaps this ECA served as a hybrid of the previously mentioned dichotomy of males joining science ECA and females joining theater and drama ECA (Olszewski-Kubilius & Seon-Young, 2004). Once students were drawn into the club for friends or fun, they potentially experienced different actions and shifted identities as males entering into a more theater-like ECA and females entering into a more science-like ECA.

Reasons given for participation did appear to be influenced by school conditions, home influences and career aspirations (Tamir, 1990-1991). However, reasons for joining an ECA, i.e., fun, interest in science, interest in working with children, are elements provided by the members, and, thus, are not design elements provided by an ECA, although considerations of how students think and feel about joining an ECA would be beneficial to encourage enlistment and longevity.

Perceptions. Not only did the intentional choices or reasons contradict the literature reviewed, the respondents contradicted themselves and these contradictions offer valuable insights into some of the roadblocks in science education today. The notion that the club would be fun contradicted the stated perceptions of many members who described science when they were teenagers as being the exact opposite of fun. Contrary to findings that members join because they already excel in the topic (Chambers & Schreiber, 2004), several former members (29%) reported initial apprehensions about joining a science ECA. Their perceptions of science made them hesitate to accept science as the basis for anything, including a 'fun and enjoyable' ECA. Being put in discrepant situations, making an *un-fun* subject fun for their audiences allowed these members to see the contrast between science and their perceptions so they could make informed decisions about the nature of science (Painter, Tretter, Jones & Kubasko, 2006).

Interjecting their own perceptions about science into their young audiences, former members (20%) described how they tried to change negative perceptions of the elementary children in order to make science more fun and to add a little silliness to make science more vibrant. In reality, the Whiz Kids were really working on their own prior perceptions of science as being dull, strange, incomprehensible or boring. Vygotsky's (1978) premise of learning from more capable peers (those interested in science integrated across squad composition) might also have enhanced the reconfiguration process of these perceptions for members and their audience.

Educators need to be aware of how students think, in this case about science, to enhance student learning (Fredricks, Blumenfeld & Paris, 2004). They need to address prior perceptions, such as only smart people can do science and those who do science are boring people, based on responses given in this study. Learning environments must address perceptions of science and learning. These perceptions influenced the reasons why students joined the club, were cognitively engaged in the club, worked well together, and persisted toward tasks or goals. Students cited the reasons they joined the club as the perception that it was fun (contrary to many comments affirming that science is just the opposite; i.e., boring, dull, awful, etc.) or aligning with their interest in science or in working with children. Perceptions underlie the reason they believed that they could all worked together so well, i.e., all Whiz Kids loved science. To overcome roadblocks to learning, engaging science ECA and classrooms must provide authentic learning environments where members can explore and challenge bogus perceptions, based on actual experiences.

Significant perceptions surfaced again in the examination of the outliers to the correlation between cognitive persistence (CEP) and improving demonstrations, posing additional concerns. These eight members indicated no additional time or effort beyond expectations to master or improve their presentations and the only change in their presentations was their own increased confidence and comfort levels. They may have spent time and effort and simply not reported that. On the other hand, these contradictory comments may indicate other perceptions that also need to be addressed by sponsors and teachers:

> “It is ability, not effort, that enables a person to do well in science,”
> “Exerting more effort to improve understanding will not help if a person is not ‘smart’ in science,”
> “A confident performer is more accurate than one with less confidence;”
> “More repetitions increase a person’s confidence as well as the accuracy of the work.”

These perceptions of learning, particularly the effort versus ability differential hindered some members from realizing their full potential, but no one had joined the club to straighten out their perceptions. Once again, an engaging science ECA must include authentic learning environments that are invaluable to students so they can explore and reevaluate their perceptions regarding science and learning.

Valuable Learning Experiences. The findings within cognitive engagement (CE) of this study repeatedly tend to focus on valuable learning experiences (CEE) as an essential element for an engaging ECA. Valuable learning experiences and cognitive engagement show one of the highest correlations in this study and seems to encompass other variables, such as challenge, life goals, and persistence in addition to addressing perceptions. Challenging experiences (CEC) in SSWK ranged from just overcoming their perceptions and fears of science to learning several demonstrations at a time. Members mentioned challenge in learning content mastery and application as well as in the educational principles involved in teaching elementary school children and making the learning meaningful for them. Life goals received fewer comments than CEE and CEM, perhaps this was because some of the less mature members had not considered or made decisions about life goals yet.

Valuable learning experiences (CEE) were highly prized by respondents as reasons why they liked about the club (43%). In addition, valuable learning experiences were the basis for most CE comments (33%, more than twice the number of comments about life goals), and were also the motives given for persisting to meet goals and improve their presentations (13%). They are also by-products of Bakhtian dialogue, the process of giving utterance to communicate with others and to construct meaning of abstract concepts (Bakhtin, 1965c).

Because they saw their actions as valuable learning experiences (CEE), SSWK members made a deliberate choice to persist toward meaningful goals, rather than being satisfied with their current level of individual and collective performances. Students intentionally exert more effort and persist longer when they perceive their actions or the activities as worthwhile, rewarding, challenging, and directed to life goals or values. Whiz Kids indicated perceived competency, challenges and benefits, peer relationships, and emerging identity as reasons for their persistence (Eccles, Barber, Stone & Hunt, 2003; Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002). Thus, persistence is a subset of valuable learning experiences and a supplementary element of an engaging ECA, supplied by the members.

Skill Mastery. In addition to valuable learning experiences, skill mastery (CEM) seems to be another essential component for an engaging science ECA. Members indicated that they liked learning new skills, with many members, particularly those in the club longer, indicated switching demonstrations and later, joining other squads to learn more demonstrations. In several instances, mastery of new skills changed their perceptions. SSWK members indicated that the overall organization and training of the club gave them a chance to learn the necessary new skills, attitudes, and values for their presentations. Clear organizational guidelines, particularly on safety matters, with emphasis on increasingly complex skill building and challenge align with findings by Mahoney (2000) and McLaughlin and Irby (1994).

Frequently, members seemed to view the training component as a specific event, a component of routines and expectations, rather than as ongoing skill mastery that evolved with practice and cognitive persistence. Skill mastery (CEM) began with training sessions, but surprisingly, the training component is only weakly correlated to cognitive engagement scores and to skill mastery. This may indicate that the training to become a Whiz Kid was not that challenging cognitively. The challenge in skill mastery did not come from the concepts themselves. According to four respondents (4%), the concepts had been previously studied and were of a basic nature, supporting the remedial nature of ECA deplored by other researchers (Baker, Akiba, Le Tendre & Wiseman, 2001).

Rather, the skill mastery (CEM) that required the cognitive engagement of the members developed with the application or verbalization and presentation of the concepts. Bakhtin (1986) stated that an utterance can only exist if produced by a voice; that these voices interact and create the meaning; and that meaning is not transferred but is constructed by voices engaged in a dialogue. This dialoguing, the process of producing a voice to communicate with someone (in this case, with their squad members and with the elementary school children) and constructing meaning provided both the challenge, skill mastery, and valuable learning experiences for the Whiz Kids, not the training itself. The process of producing a dialogue and creating meaning with others supports both essential elements of skill mastery and valuable learning experiences for an engaging science ECA.

Skill mastery (CEM) of the former Whiz Kids could have been confirmed through academic achievement, which is the most frequently attributed benefit for ECA participation (Darling, Caldwell, & Smith, 2005; Feldman & Matjasko, 2005; Gerber, 1996; Gifford & Dean, 1990). However, without high school records or access, measures of skill mastery for SSWK members in this study relied on self-ratings. Mastery was indicated by perceived increases in science knowledge, measures of some scientific attitudes, perceptions about elementary children learning from them, and an expressed need for more inquiry in schools. Whiz Kids made 109 remarks, or 20% of all cognitive engagement comments describing their mastery of concepts learned. Self-ratings are characteristically high (Xie, Mahoney & Cairns, 1999) and the ratings by these respondents reflect a very high confidence level. According to survey respondents, 74 (80%) former members perceived that their knowledge of science had increased because of their participation. Their ratings may be over-exaggerated, but affirm that it is the participation in the activity that develops these values and aspirations in the students, not the beliefs held prior to participation (Darling, Caldwell & Smith, 2005).

Members with higher skill mastery levels perceived that they had learned more science content knowledge while participating in the club activities. Several respondents emphasized that it was because their visual learning styles were effectively addressed through the club presentations. Spatial visualization skills improve science learning, particularly for girls (Day, Langbort & Skolnick, 1982; Huppert, Lomask & Lazarowitz, 2002; Quaiser-Pohl & Lehmann, 2002).

Of significance and in alignment with other studies are the differences in expressed knowledge gains based on gender. Females indicated significant gains in complex science knowledge while males acknowledged gains, but smaller ones, or indicated that any gains merely reinforced prior basic knowledge. While gender disparities within the club or study outcomes were not observed, it appears as if there were different entry knowledge levels by gender, which confirm findings in other studies (Hoffmann, 2002; Kahle, Parker, Rennie, & Riley, 1993; and Sadker & Sadker, 1993).

ECA participation for improving reasoning skills more so than for improving academic achievement (Everson & Millsap, 2004). Survey respondents rated themselves on various scientific qualities but only a few weak correlations regarding science attitudes were uncovered. Respondents who rated themselves higher on respect for the views and opinions of others also rated themselves higher on open-mindedness and flexibility. Perhaps they are also those who commented on working well together.

Surprisingly, avowed skill mastery (CEM) included several skills that were never taught but developed and used by Whiz Kids to improve their demonstrations and adjust their presentations to various age groups. Skills involved evaluating whether audiences were engaged in their presentations and learning the content in order to apply techniques and strategies to increase participation were mentioned. The vast majority of respondents (82%) perceived that they were successful in engaging the elementary children, with 53% citing specific evidence and actions by the children. How these assessment skills that were never taught were developed and implemented is a topic of a future study.

CE Summary. Thus, the essential elements of cognitive engagement for a theoretical framework qualitatively distill to reveal valuable learning experiences (CEE) and mastery of new skills (CEM). While time is an investment that students must make in a club and not a design element for behavioral engagement, reasons for joining and perceptions are also investments that students must make in ECA and not a design element for cognitive engagement. However, an engaging science ECA design needs to be aware of prior perceptions and reasons given for joining an ECA and to provide an avenue to express voice, explore, and experiment in order to remediate prior perceptions through discrepant situations and various skill sets. Based on these prior perceptions, the bottom line for enlisting members into a science ECA may be “sell it well.”

CE Future Studies. Future studies indicated for cognitive engagement include but are not limited to investigations regarding Bakhtian dialogue and valuable learning experiences, perceptions of science ECA being fun versus perceptions of science not being fun, joining science ECA while affirming aversion to or no interest in science, and ability versus effort controversies in science learning and achievement. Other future studies indicated from this study include such issues as spatial visualization skills to improve science learning, particularly for girls; science attitudes versus reasoning skills, the development, implementation and implication of skills that have never been taught; and the benefit of CE for members who participate in ECA that meet after school versus those that involve leaving the school building during the school the day.

Emotional Engagement (EE)

This study investigates emotional engagement (EE) and its eleven variables, namely, (1) activities (EEA), (2) belonging (EEB), (3) working with children (EEC), (4) emotional responses (EEE), (5) working with friends (EEF), (6) interest in science (EEI), (7) working with new peers (EEN), (8) parental interest (EEP), (9) ties to the school (EES), (10) teacher influence (EET), and (11) wearing costumes (EEW). Emotional engagement responses constitute 46 %, or nearly half of all survey engagement responses. Emotional engagement shows the highest correlation to overall ECA engagement scores, higher than behavioral and cognitive engagement. However, emotional engagement itself is only moderately correlated to the various EE variables. This discrepancy between correlations may indicate that the survey collected little quantitative data and was generally more qualitative, or that it did not tap into the more critical issues related to the emotional engagement of the members. It may also indicate that as adults, these former members were less emotional than they might have been as teenagers, or that the time between participation and the survey failed to collect the more poignant critiques they might have made earlier when the memories were still sharp and clear, or that perceptions have changed with age and experience. Perhaps it is some combination of all these factors. Emotional engagement also offered some notable support and contradictions to the related literature.

Impact of Gender. The greatest contradictions to the literature regarding emotional engagement encompass those responses that correspond to the same contradictions cited for behaviors and cognition. As in behavioral engagement, positive emotional responses contradict the literature, regarding gender in science ECA. Females reported having fun while learning science, including physical science topics, contradicting many studies (Debacker & Nelson, 2000; Jones, 1991; Lawton & Bordens, 1995). Females enjoyed participating and working with physical science topics, offering several positive emotional responses that contradict findings of other studies (Bell, 2003; Howes, 2002; Kahle, Matyas & Cho, 1985). It seems unusual that none of the respondents voiced any gender issues, but perhaps this is reflective of the safe environment within the club structure.

This study shows no correlation for gender with respect to any variable tested, with no gender difference present in participation, choice of experiments, or leadership, contradictory to some findings (Kahle, Parker, Rennie & Riley, 1993). The value-based ECA may have helped to improve female beliefs and career aspirations in science (Baker & Leary, 1995; Hanson & Kraus, 1998; Kerr & Robinson-Kurpius, 2004). However, none of the variables measured in this current study showed any significant correlation to the gender of the respondent. These strong contradictions seem to resonate with some of the members' prior perceptions discussed previously.

While the exit levels of skill mastery showed no gender differential, the differences in the gains reported were very gender-related. This study seems to contradict findings of many gender-based studies. Perhaps this is due to the constructs of the club being so closely aligned to Kahle's (1983) recommendations for ways to encourage girls in science, a study that occurred during the same year as the club's formation and Handel's (1986) assertion that improving girls' self-concept gives them self-efficacy to accept new challenges and take more risks.

Emotional Engagement and Reasons. Similar to the contradictions in the cognitive engagement results, the strong positive emotional responses (EEE) regarding reasons given for joining this science ECA, “sounded like fun!”, also contradict numerous studies. In addition, the high percentage of seniors in the club (67% average, with 44% female seniors) tends to contradict findings that female interest and enjoyment in physics decline through schooling (Murphy & Whitelegg, 2006). With 29% currently in scientific careers and 5% in science teaching, respondents appear to support findings that science ECA promote an active intrinsic interest in science that is strongly related to a preference for a science career (Hofstein, Maoz & Rishpon, 1990; Jacobs, Finken, Griffin & Wright, 1998; Miller, Lietz & Kotte, 2002; Stake & Mares, 1998).

Emotional Responses and Personal Interests. Emotional responses (EEE) and personal interests (EEC, EEI) seem to be essential elements of emotional engagement. General emotional responses (EEE), those not directed toward a specific source, accounted for 28% of all emotional engagement responses and for 43% of the most memorable moments. Personal interests of the respondents were centered on working with children (EEC) and science (EEI). Working with children (EEC) received the most responses for most memorable moment in SSWK, being mentioned 55 times (60%), while interest in science (EEI) was listed 40 times (43%).

Interest in Science. Significant contradictions deal with interest in science (EEI). Respondents shared negative emotional responses regarding science that contradict findings that those in ECA are already excelling in the subject area (Chambers & Schreiber, 2004). Nearly one-third of the respondents indicated very strong negative to no interest in science (prior to joining SSWK). Many of these strong aversions to science reportedly had their origins in science fairs, contrary to findings in other studies (Eylon, Hofstein, Maoz & Rishpon, 1985; Simpkins, Davis-Kean & Eccles, 2006). These strong emotional responses refute any claims that simply increasing student participation in science fair projects of their own interests will increase student engagement in the science classroom (Wilson, Cordry & Uline, 2004). Perceptions about science surfaced in cognitive engagement as well as in emotional engagement, revealing how students think and feel about science and showing the depth of the roadblocks to learning science.

Even though nearly one third of the respondents acknowledged that they did not like science personally, survey respondents still asserted that every member in SSWK loved science. It would appear that no one told anyone else of his or her apprehensions or fears of science. Perhaps they all accepted the Thought for The Day on the chalkboard by Robert Stevenson, "Keep your fears to yourself, but share your courage." Shank's (2006) lantern sheds illumination and insight on some of these contradictory comments when combined with the knowledge of the sponsor's practice to assign students to squads in such a way as to balance them according to gender, race, age and science competency levels, as explained in previous chapters. This finding may have significance in ECA and classroom grouping strategies, in that zones of proximal development (Vygotsky, 1978) that include members with a range of interests allow students to benefit from the enthusiasm of others for their areas of expertise or subject matter.

Perceptions about Science. The emotional engagement responses comprised nearly half of all engagement responses and almost one-third of all responses. Most importantly, the emotional engagement component highlights important feelings and perceptions of adults who still remember their apprehensions about science and their perceptions of how others view science. These feelings and perceptions were stated by adults concerning a time when they were teenagers. In several instances, their comments raise serious questions as to whether these are the perceptions they had as teenagers or now as adults, whether these adults still labor under these perceptions of science, whether adults instill these perceptions in their children, what percentage of people have similar perceptions if one third of the members in a science ECA do not like science, etc.

In addition to their stated aversions, entry-level perceptions about science by these former Whiz Kids are apparent from the implications in their remarks of how they *had to make* science fun, exciting, interesting, etc. for the elementary school children. Since the club never talked to young children about their attitudes toward or perceptions of science, the Whiz Kids must have been interjecting their own perceptions of science as if they would also be those of the children. Supposedly, to the *children* then, science was:

- Boring, uninteresting, unexciting (36 respondents, 39%)
- Not fun (51 respondents, 55%)
- Done by boring people, dorks, nerds (3 respondent, 3%)
- Done in a classroom, read in a book, something to memorize (14 respondents, 15%)
- Too abstract, complex, inaccessible, dreaded or not enjoyed (12 respondents, 13%)

These perceptions seem more comprehensive of the unattractive images that the general public has of science than the ones that depict all scientists are male, wear white lab coats, only do experiments and especially, that they are weird, boring and work alone (Painter, Tretter, Jones & Kubasko, 2006). While one study shows perceptions about the characteristics of who fits the mold to be a scientist, this study discovers the perception that no one cares if they fit the mold to be a scientist.

There is a tremendous need to change these perceptions if students are to be successful in science class and enhance their learning and achievement in science and there is hope. Engaging costumed Whiz Kids in countless hours of doing science experiments for elementary school children appears to have changed many of their perceptions about science. The extent of their individual changes, whether they chose to continue in science, chose science careers, or were just no longer afraid of science, is not as important as the fact that it has been possible to address and change their perceptions.

Changing perceptions appears comparable to changing social positions, where changing social positions entails becoming an entirely different person (Bishop, Bishop & Bishop, 2004). Changing perceptions seems to have occurred for Whiz Kids by wearing silly costumes and role-playing as entirely different persons, as ‘science experts.’ The changes seem to have occurred quite naturally and painlessly through these behaviors and certainly without overt discussions that they need to change their attitudes toward science. According to 77 respondents (84%), their emotional engagement in SSWK improved their attitudes toward science, with 60 (65%), indicating a significant positive improvement. No measure was taken as to whether they could actually imagine themselves as scientists, to validate other studies (Sorge, Newsom & Hagerty, 2000). The fact that there are very weak or no correlations of changed attitudes with the other variables in the study seems counterintuitive and needs further investigation.

Other Emotional Engagement Variables. Other than emotional responses (EEE) and personal interests (EEC, EEI), emotional engagement includes several variables that elicited fewer responses or responses that were more difficult to code using the schema chosen. These include emotional responses to other people and feelings of belonging, specifically, friends (EEF), new peers (EEN), parents (EEP) and teachers (EET). Positive emotional engagement was evident regarding working with friends and new peers as well as feelings of belonging. Respondents made 66 comments about joining a science club because of friends and enjoying the experiences they shared there. Their positive comments tend to contradict findings that outside school activities, rather than classroom experiences, attract more students to physics (Reid & Skryabina, 2002).

Other less cited EE factors also include emotional responses to club activities (EEA) and school ties (EES). ECA participation offered opportunities to relax and unwind from outside pressures in an accepting, non-threatening environment (Shannon, 2006). Relaxing with friends in a secure environment became even more critical for some with changes in family situations (Luthar, Shoum & Brown, 2006). More students participated in SSWK percentage-wise at the smaller private high school (~ 6%) than at the larger public high school (~ 1%), but those at the public high school reported more significant impact of SSWK on their overall high school experience and on their personal and professional lives. This tends to support findings that larger schools are generally less engaging (Crosnoe, Johnson & Elder, 2004). The corollary to this finding is that because larger schools may be less engaging, when student do participate in ECA, their participation tends to become more significant in establishing bonding with teachers and the school than it does in smaller schools.

Finally, respondents gave positive emotional responses about wearing costumes (EEW). Although some respondents skipped some survey questions, the question dealing with wearing costumes was answered by every respondent. Three (3%) said they did not remember any impact due to costumes, three (3%) said they had little or no impact, and six (7%) said they just did it to meet club expectations. However, an overwhelming majority, 80 respondents (87%) offered very poignant comments about wearing costumes

EE Summary. To summarize, the two essential elements of emotional engagement for a theoretical framework qualitatively distill to include emotional responses (EEE) and personal interests (EEC, EEI). Emotional engagement is a major component in engagement, yet at times, nebulous as to the critical variables. While many variables were included in this study, they generally show only moderate correlations. This may be due to the diverse and aged nature of the participants, the close interactivity of the EE variables, too many variables that dissipated the essential elements, or the inability to code written responses accurately for their emotional content. It may also be indicative of the wide range in the emotional makeup of each individual, so that many expressive responses contribute to emotional engagement.

EE Future Studies. Future studies regarding emotional engagement may include but are not limited to the ardor of the teacher for the subject matter versus student engagement (which has not been addressed in this study, but might also prove insightful), changes in attitudes and their impact of engagement, more effective ways and instruments to measure EE, more reliable quantitative measures of attitudes toward science and scientific attitudes, and classroom studies implementing Kahle's (1983) recommendations on ways to encourage girls in science. Future studies may also include voluntary versus compulsory science fair participation, grouping techniques that incorporate interest factors, outside ECA versus classroom activities for attracting more people to science, science ECA in private versus public schools, adolescent versus adult perceptions of science, sources of adolescent perceptions versus parental perceptions, and correlations of attitude changes and emotional engagement.

Theoretical Framework for Engagement

Qualitative Essential Elements

Building a theoretical framework for a science ECA from this study based solely on engagement investigates 24 variables. According to the respondent comments, correlations, contradictions and discussions from a more qualitative perspective, the most essential elements appear to be the following:

<u>BE (behavioral engagement) variables</u>
- cooperative interactions with peers (BEW)
- cooperative interactions with teacher (BET)

<u>CE (cognitive engagement) variables</u>
- valuable learning experiences (CEE)
- mastery of skills (CEM)

<u>EE (emotional engagement) variables</u>
- emotional responses (EEE)
- activities centered on personal interests in science (EEI) and
- activities centered on personal interests in working with children (EEC)

The resulting framework has fractionally distilled engagement of 24 variables down to seven essential variables qualitatively. At the same time, the distillate still includes aspects of other variables. For example, skill mastery includes challenge and persistence, interactions with teacher and activities encompasses some routines and expectations, etc.

Quantitative Regression Analysis

A quantitative statistical analysis using multiple regressions and computer software was conducted to see how these three engagement components as measured by these 24 variables act together to provide a theoretical framework for an engaging science ECA. The target variance of the engagement composite is set at 80%, meaning that the essential elements distilled would account for 80% of the variance in the overall ECA engagement of the club members. Change theory shows that 20% of the people are open to change and will embrace new ideas and that this 20% with their enthusiasm will draw in 70%. Ten percent may never be willing to change, but by that time, 90% of the people will have changed, establishing a new norm of behavior or belief. So the distillate is less ambitious than change theory, but still realistic.

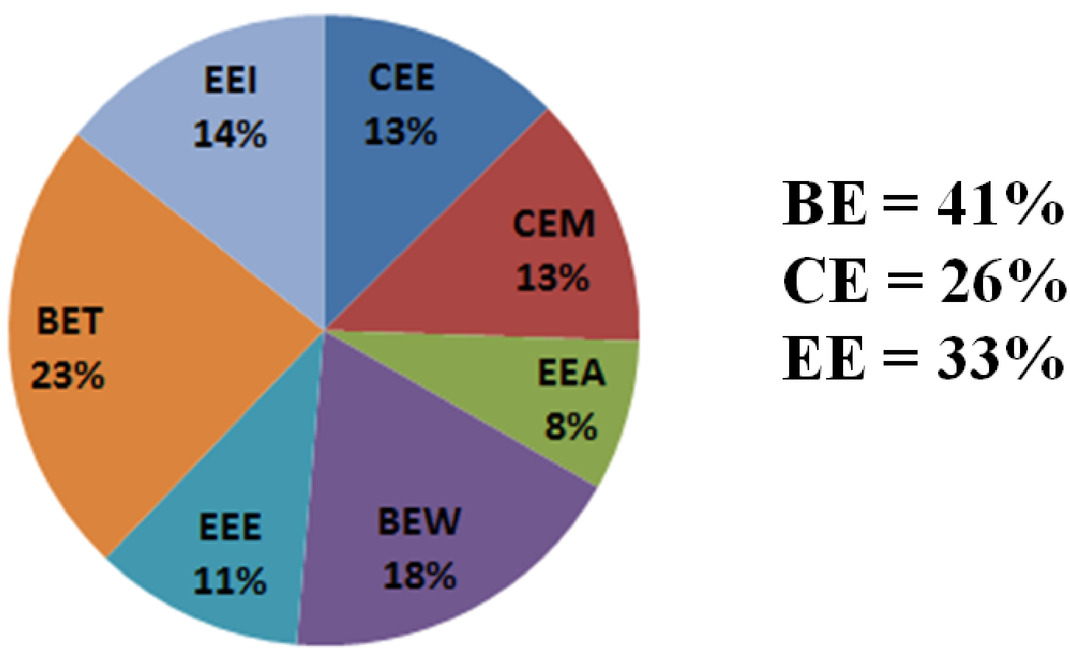
A Theoretical Model for Engagement

Of the various models and combinations of the 24 engagement variables examined, the most successful regression model ($F_{(7, 91)} = 53.228$; $\rho = 0.000$) shows a correlation factor, $r = 0.903$. After correcting for interaction factors ($r^2_{adj} = 0.816$), these essential elements account for 80.1% of the variance of overall ECA engagement in how members behave, think and feel in this science ECA. These seven elements (see Figure 3) are (1) teacher interactions (BET), (2) working well together (BEW), (3) valuable learning experiences (CEE), (4) mastery of new skills (CEM), (5) interesting activities (EEA), (6) emotional responses (EEE), and (7) interest in science (EEI). This quantitative model shows close correlation with the qualitative model, where interest in working with children (EEC) is superseded by interesting activities (EEA). This seems like a realistic substitution, since not every science ECA needs to focus on working with children.

While every science club may not necessarily need to include wearing costumes, the opportunity to role-play or to act out significant roles or prominent scientists, or major historical science events or concepts, perhaps role-play through technology may be an aspect that ECA sponsors should consider incorporating into their science club structure. Role-play builds mastery and self-confidence as students repeatedly verbalize, refine and embellish their own understanding of concepts with relevant applications.

Technology capitalizes on student interest and enthusiasm for video games and role-play simulations, allowing teachers to embed complex gaming and simulation environments into educational contexts and incorporate websites and blogs for increased interactions (more capable peers concept) and constructivist learning environments (Appelman, 2005; Dickey, 2003). This might take on the form of online characters that perform demonstrations, chat rooms hosted for younger children to ask high school students science questions, or interactive sites that focus on a learning environment that promotes inquiry, such as allowing operators design and conduct their own inquiries, change the values of variables.

Figure 3. Theoretical Model using only Engagement Variables



Thus the essential elements for an engaging science ECA would include positive, synergistic interactions between teacher/sponsor and members working well together in interesting science-related activities that are also valuable learning experiences, going beyond lessons in classrooms and offering the opportunity to learn and master new skills. This description reminds me of the preliminary stages for Lego Logo, working in teams to build and program a Lego robot to achieve a specific task, and Science Olympiad, working in pairs to investigate a phenomenon, solve a real-world problem, or build a mechanism to achieve some task. However, both of these clubs turn highly competitive at the next stage, altering the less stressful preparation environment. The emotional element is there for those already interested in science but these clubs do little to engage the reluctant person into science or to address science perceptions. The teacher plays a major role in establishing and monitoring rules and routines. The alter-ego of science expert is missing and the fun and giggles are not as apparent, occurring perhaps at the end of the tournaments, if successful.

The Engagement Only Model verifies the work of Fredricks, Blumenfeld, and Paris (2004) regarding the three essential components of engagement (BE, CE, EE). However, the theoretical model designed thus far only includes engagement. Knowing how students behave, think and feel is complemented or complicated, depending on one's point of view, by social positioning that also influences these actions. The variables of identity formation will now be combined with the engagement variables to design a theoretical framework for an engaging and socially constructive science ECA.

Unpacking the Essential Elements of Identity Formation

Social Positioning (NP)

This study also investigated social positioning (NP) and its five variables, namely, (1) new actions (NPA), (2) costumes (NPC), (3) identity (NPI), (4) perspectives or points of view (NPP), and (5) teamwork (NPT). Social positioning (NP) constituted 17% of all responses and half (52% of all identity responses) of all identity comments and shows a strong correlation with overall identity formation. This component shows several correlations while offering support and the fewest contradictions to the studies reviewed.

Social positioning (Bishop, Bishop & Bishop, 2004; Currie, Kelly & Pomerantz, 2007; Eccles & Barber, 1999; Eccles, Barber, Stone & Hunt, 2003; Eckert, 1989; Eder & Parker, 1987; Fredricks, Alfred-Liro, Hruda, Eccles, Patrick & Ruan, 2002; Jacobs, Vernon & Eccles, 2004) was evident in SSWK from the beginning. Responses from 18 former members (20%) stated that their friends ‘made them do it’: “My friend Nelly of the Nile convinced me to join because she didn't want to do it alone. I'm glad she did, I became Pammy Pumpkin.” (14) Social positioning was evident in the reasons given for joining the club, the entry level positions as they attended the first meeting, and the labels they gave other club members. While some researchers disparage peer harassment and crowd selection for manipulating social positioning (Bishop, Bishop & Bishop, 2004), SSWK specifically separated and mixed peer groups into science squads. The members’ new positions or identities were manifested in their wider circle of friends and enhanced interpersonal skills the Whiz Kids developed as a result of their participation in SSWK.

The process of how teenagers choose friends may further support the importance of ECA in making changes in social positioning, particularly, academic ECA that draw together students of similar interests, rather than friends based on physical characteristics, proximity, history, families, chance meeting, etc. (Kao, 2000). As stated earlier, the Whiz Kids joined the club because their friends joined or because their friends wanted them to join, but they made more references to the new friends they made or just the club members in general rather than to the particular friends who had influenced their decision to join. So friends were important and enhanced social and communication skills, but once they joined the club, members perceived that they made more friends, perhaps based more on common interests, increasing their circle of friends.

Changing social positions and increasing the circle of friends that shared their interests would tend to confirm, or validate their self-confidence, skills development, and special interests (Hansen, Larson & Dworkin, 2003; Hansen, Larson & Moneta, 2006), and further accelerating them along future trajectories based on these interests and changes. Further study is needed to verify if joining different clubs allow students to try the fit of new friends with interests that may better match their own interests than their current friends. Changing social positions once they are set necessitates becoming an entirely different person (Bishop, Bishop & Bishop, 2004), but joining an ECA opens doors of opportunities to make new friends based on mutual interests, rather than location, families, etc., and to explore new social positions with different future trajectories of identification. If this is all that is essential, then the findings of Wilson, Cordry, and Uline (2004) would have more validity as they urge that simply increasing student participation in science fair projects of their own interests will increase student engagement in the science classroom. The intricate interweaving of engagement and positioning must be intact for engagement, at least certainly the emotional encouragement and support of friends to venture into new positioning or ECA to test the fit. This is an important tenet of the final theoretical model developed in this study.

One of the key correlations in this study is that changes in social positioning are strongly correlated to cognitive engagement and overall ECA engagement. Members had to be thinking and mindfully engaged to experience and recognize these changes in their social positions. Just as importantly, behavioral engagement was only moderately correlated to positioning, so just 'going through the motions' may not be as effective in enabling these changes (Weiss, Little & Bouffard, 2005). Further studies in this area are needed. Respondents stated that some members did not really like kids and were just there to be with their friends and get out of school (Kao, 2000), depicting the adage that 'birds of a feather flock together.' The absence of any correlation with behavioral engagement might also explain why the theoretical model for engagement and the theoretical model for engagement and identity are so different, because BE has not been shown as essential for identity formation.

This trend regarding behavioral engagement seems to follow the discourse of social scientists regarding the basis for human actions. Perhaps BE is the beginning point for CE and EE, just like new social positioning precedes new trajectories of identification. Wertsch's (1991) asserts that actions should be the point of analysis. Perhaps actions or BE engages EE, which then establishes CE. Following Bruner's (1990) logic that culture and quest for meaning are the cause of human actions, it would follow that CE and EE would precede BE, where behavioral engagement, or actions are only outer manifestations of the significant processes involved in CE and EE. Based on Vygotsky's (1978) premise that social communicative processes influence the positioning of individuals into their social roles, the views they will hold of themselves within the social culture and thus, the actions they will take, this might ascribe that BE and EE are the social communicative processes that lead to internalized and higher order thinking, CE. In this study, it was the actions (BE) taken in joining and belonging to SSWK (EE) and there they learned mastery skills (CE) and values that have stayed with them, and in the process, experienced new social positions (NP).

New Actions. The essential elements of social positioning for a socially constructive ECA seem focused on new actions, teamwork and perspectives with the other factors serving as supporting processes. The first essential element, new actions are associated with the new positions in which Whiz Kids found themselves through costuming and are evidenced as members learned new things, particularly about themselves (Waterman, 1984), participated in new experiences, those with a clear purpose (Cushman, 2006) and found new applications (Hart, 2005) around curricular themes (Wortham, 2008).

Surprisingly, cognitive engagement and emotional engagement are more robustly correlated to new actions (NPA) than behavioral engagement. This may perhaps mean that just being present in the club does not reap the same rewards in social positioning as it does for participants who are cognitively and emotionally engaged in the club activities, i.e., those members who were just ‘going through the motions’. Responses from members, especially some one-year members that tended to be more behaviorally engaged seem to offer support of members who were ‘going through the motions’ without realizing the new positions in which they were placed. Further investigation of this possible correlation is indicated.

During these new actions, students build skills and attributes that later become internalized into self-images, promoting identity formation and abstract thought (Pinciotti, 1993). Those who embraced the new positions accepted new actions and challenges, such as speaking in front of groups, learned many new things about science, experienced the wonder of teaching young children, and found new applications for concepts taught at school. They also seemed to convince themselves to like science by acting out the role of making science interesting to elementary kids. These members were somewhat more likely to be more cognitively, emotionally and overall actively engaged in the club. Thus, new actions seem to be an essential element of a socially constructive ECA.

Costumes. The use of costumes in SSWK eliminates social positions and creates a sense of unity and new ways of interacting with people (Bakhtin, 1965). Costumes provided the venue for assuming new positions and new actions. However, the unique nature and purpose of costumes in SSWK may not necessarily make it an essential element for every ECA, and certainly not every science ECA. Otherwise, science ECA may disintegrate into Chemistry Clowns. For SSWK, costumes were purposefully used to get and keep the elementary school children's attention, provide a sense of fun, and help children feel more comfortable with the Whiz Kids. But they also provided roles behind which Whiz Kids could hide if they were shy, and allowed members to 'test the fit' of new identities as 'science experts' (Currie, 1991; Guest & Schneider, 2003; Rounds, 2006). Costumes were fun, but not essential for every ECA.

New Identities. New identities (NPI) were only weakly correlated to overall ECA engagement and cognitive engagement, and showed no correlation with behavioral or emotional engagement. This may not be as surprising as first expected. Having reviewed the entry-level perceptions that many Whiz Kids exhibited, 'testing the fit' of a 'science expert' was definitely overshadowed by the immense task of overcoming their perceptions, so new identities would have to wait until members first addressed their perceptions of science. New identities (NPI) may be an essential element of a socially constructive ECA, but the data from this study does not support it.

Teamwork. The second essential element of social positioning appears to be teamwork. Those who worked collaboratively toward a common goal and built a sense of community were somewhat more likely to be more cognitively, emotionally and overall more actively engaged in the club. BE was once again, only weakly correlated to the positioning variable, NPT. Teamwork and social skills are important facets of identity formation as well as initiative, peer relationships, and understanding others (Dworkin, Larson & Hansen, 2003). Teamwork and other life skills were also given as rationale for the high parent support of ECA (Bishop, Bishop & Bishop, 2004). Larger school size is faulted for decreasing ECA participation and interpersonal dynamics (Crosnoe, Johnson & Elder, 2004), but former Whiz Kids attested fervently to their outstanding teamwork. Teamwork that may have begun as a standard operating procedure to just get along with others (BEW) escalated into an overriding sense of community for the Whiz Kids, verifying the importance of connectedness and collaboration (Berkowitz & Simmons, 2003; Hart, 2005; Marsh, 1992; McNeely, Nonnemaker & Blum, 2002).

Communities of practice and positioning voices (Dison, 2004) appear to match what social positioning in SSWK was doing: putting a different mix of kids together to help them develop their voices under the guise of helping others. Learning occurred best in increasingly focused communities of practice, not communities of friends per se (Dison, 2004), much in the same manner as the SSWK squads were formed. Members practiced in small groups (squads) and many respondents attested to receiving help from or working with other squad members, supporting assertions by others that cognitive structures are formed socially and then reconstructed internally (Vygotsky, 1978; Scardamalia, Bereiter & Lamon, 1994). Whiz Kids also attested to the increased learning through countless repetitions (Lemke, 2000).

The mind and thus, mental actions are socially situated (Bruner, 1990; Vygotsky, 1978). With similar reasoning, rather than hosting a large assembly at schools up on a stage removed from their audiences, SSWK presented demonstrations in individual classrooms in order to increase personal contact and enhance the social learning aspect of teenagers working directly with elementary school children. Whiz Kids frequently mentioned how elementary school children would move closer to the Whiz Kids or sit in circles around performers to watch transfixed at their demonstrations. As the Whiz Kids worked together more cooperatively to perfect their demonstrations and timing, their cooperation, perspectives of others, and teamwork evolved into an increasing sense of community, perhaps emulating those communities of practice (Dison, 2004). Thus, teamwork appears to be an essential element of a socially constructive ECA.

New Perspectives. The third essential element appears to be perspectives (NPP), which yielded 278 comments (43% of all positioning comments) regarding new perspectives or points of view, and one of the highest correlations with new social positions. New social positions and actions are difficult to assume if students have never considered the other person's perspective or point of view (POV). Role-play in SSWK costumes encouraged viewing situations from the perspective of others and learning to better understand people (Currie, 1991; Dworkin, Larson & Hansen, 2003). Working closely in small groups encouraged cooperation and appreciation for the point of view of others. There is a very strong, significant correlation between positioning and new points of view (NPP), meaning that those members who more consistently considered POV of others were highly likely to perceive more changes in their social positioning through their participating in the club. Changing their points of view may also foster the growth of resilience (Mahoney, Cairns & Farmer, 2003; Reis, Colbert & Hebert, 2005).

NP Summary. Thus, the essential elements of new social positioning (NP) for a theoretical framework of a socially constructive ECA qualitatively distill to include new actions (NPA), teamwork (NPT), and perspectives (NPP). Costumes and new identities support these essential elemental processes as Whiz Kids assumed new social positions. Behavioral engagement is weakly or not correlated to identity formation processes, although cognitive engagement even more so than emotional engagement are frequently correlated to positioning variables.

NP Future Studies. Future studies in social positioning may include, but are not limited to costumes versus non-costumes for changes in social positioning, cognitive and emotional engagement versus behavioral engagement to promote changes in social positioning, and NPI as an essential element for a socially constructive ECA. Other studies may include the sequencing of the three components of engagement versus social learning, namely, EE and CE, then BE or BE, then CE and EE, and the interaction effects and benefits of engagement and positioning for better learning.

Trajectories of Identification (NT)

This study investigates new trajectories of identification (NT) and five variables suggested by the data coding and classification, namely, (1) applications and resumes (NTA), (2) career aspirations (NTC), (3) educational opportunities (NTE), (4) future self-images (NTF), and (5) reflections (NTR). New trajectories of identification (NT) constituted 15% of all responses and approximately half (48%) of all identity formation comments and showed a strong correlation with overall identity formation. There are several correlations and general support for the literature reviewed, with a few contradictions. Because these variables are after-the-fact aspects, about decisions and actions of participants after social position changes, this study will define these variables as those attributes or actions of the participants since leaving high school and SSWK. As such, they cannot be considered as essential elements in the fractional distillation process to design an engaging and social constructive ECA, but they can provide some conclusive evidence of the impact of the ECA under study in support of these essential elements.

Contrary to assertions that social positions become locked (Bamberg, 2004), the new positions the Whiz Kids experienced fostered a wider circle of friends with similar interests and dispositions, the growth and development of personal attributes, presentation and leadership skills, teaching skills, and science expertise. These new positions did provide a new identity framework with new boundaries from which to interpret other scenarios, present and future situations as well as new trajectories of opportunities (Bamberg, 2004).

Educational Opportunities. Results from this study tend to support findings that after-school activities contribute significantly to the prediction of achievement (Cooper, Valentine, Nye & Lindsay, 1999) while refuting findings regarding achievement differences due to gender (Bell, 2003). Social positions impact students' orientation to education (Avis, 1997), but this is not to say that the impact has to be negative or written in stone any more than the social positions themselves are. More diverse trajectories of identifications include expanded educational opportunities in addition to new future self-images. Educational opportunities range from learning at deeper levels, formal educational pursuits, informal learning opportunities as well as an appreciation for different instructional strategies.

The high educational levels attained by the adult former Whiz Kids tend to confirm findings that ECA serve as protective factors allowing talented students to achieve at high levels (Reis, Colbert & Hebert, 2005) and that teachers can enhance trajectories with expectations and values (Van Bockern, Wenger & Ashworth, 2004). These high levels also tend to confirm findings that consistent ECA participation is associated with positive changes in educational aspirations and interpersonal competence (Cooper, Valentine, Nye & Lindsay, 1999; Mahoney, Cairns & Farmer, 2003).

Career Aspirations. This study strongly supports the assertion that to stimulate interest in science careers, educators must first address students' perceptions (Painter, Tretter, Jones & Kubasko, 2006). In science, this is a very real problem that demands deliberate attention if better learning in science is to occur. There are several outliers to the correlation between career aspirations and overall trajectory scores, suggesting that other factors are impacting these results. Plotting career aspirations by school and new trajectory scores by school yield similar patterns between schools, but do not resolve the outlier inconsistencies of the career aspirations and new trajectories correlation. The identification of the other factors is the focus of a future study.

Once again, behavioral engagement shows weak, or no correlation to identity formation variables, corroborating comments in the previous section. Cognitive and emotional engagement show moderate correlations, with cognitive engagement being cited more frequently than emotional engagement.

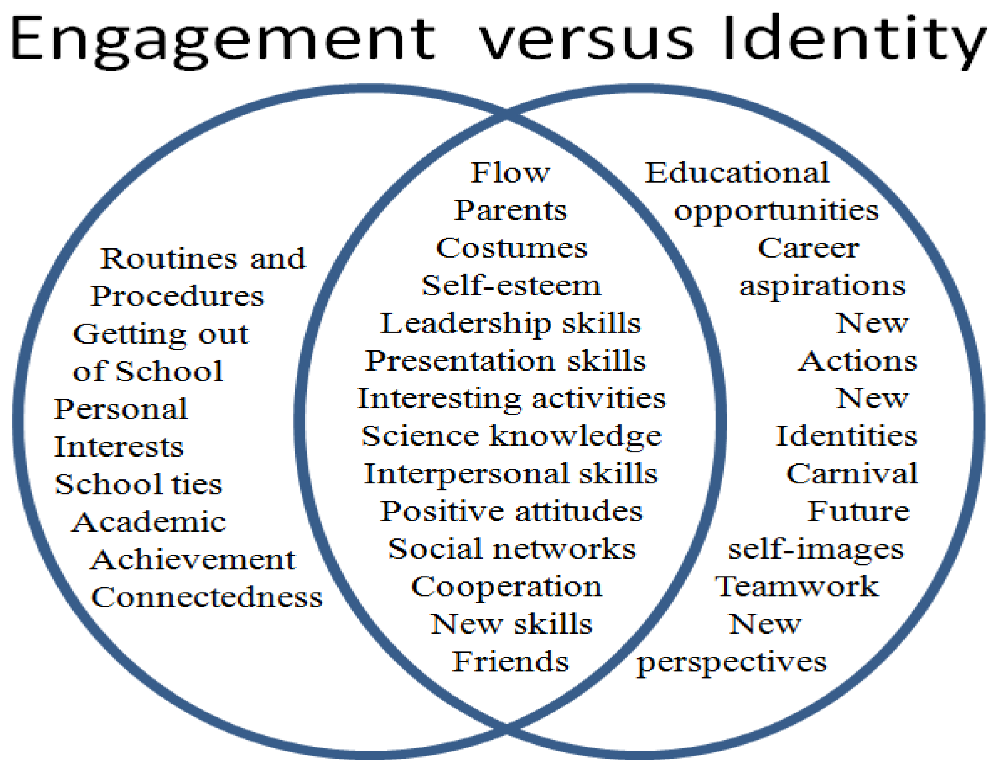
NT Summary. Thus, in this qualitative distillation, there are no essential elements of trajectories of identification in a socially constructive ECA. The literature presents new trajectories of identification (NT) as a follow-up to new social positioning (NP). Questions arise as to whether an outside force that changes the trajectory of identification (unknown benefactor pays for college, father-in-law finds person a job) would change the social position. Putting relatives into an unearned position changes their trajectory but the permanency and comfort levels in the new social position come into question. This study does not address this possibility.

NT Future Studies. Future studies may include, but are not limited to factors impacting career aspirations and overall trajectory scores; personal reflections to develop value-added ECA and promote girls in science; displaced trajectories and resulting actions, and other factors impacting trajectories of identification.

Bridging the Gap

If learning is viewed as a continuum from formal to informal learning environments and considering that social learning is internalized later (Scardamalia, Bereiter & Lamon, 1994; Vygotsky, 1978), then perhaps studies on ECA engagement are really missing, or not capitalizing on the social interaction component of identity formation that allows learning to occur. Identity can be developed through selective ECA choices (Bishop, Bishop & Bishop, 2004; Eccles, Barber, Stone & Hunt, 2003). Self-identity is of paramount importance during periods of high peer pressure and ECA participation, yet ECA engagement and ECA identity formation are generally studied separately. Yet, studies generally focus on segregated topics without tapping into the interaction benefits that can occur between engagement and identity formation, particularly in science ECA.

Figure 4. Overlap of Engagement ECA Characteristics and Identity Formations ECA Characteristics



Bridging the gap between engagement ECA studies and identity formation ECA studies encompasses recognizing the unique qualities of each school of thought and then organizing them in such a way as to identify those attributes that they share in common and those which distinguish them from the other. Instead of separating and isolating these approaches in analyzing ECA participation, it is more helpful to understand the many attributes that they both measure and value. While both categories have distinct features, students will benefit the most from participation in an ECA vested in both paradigms for adolescent growth and development into educated mature adults. Based on the evidences in the review of the related literature and the results of this study, a graphic representation (see Figure 4) of the attributes of both areas is presented to compare as well as to highlight the variables within and from each approach in order to design the most effective engaging and socially constructive science ECA theoretical framework.

Theoretical Frameworks for Engagement and Identity Formation

Qualitative Essential Elements

This study investigated 34 variables of engagement and identity formation processes that influenced the participation of and benefits realized by the former members of this particular science ECA. The 34 factors studied are not all inclusive, but simply constitute the factors revealed in this study. According to the respondent comments, correlations, contradictions and discussions, the most essential elements from a qualitative perspective appear to be the following:

BE (behavioral engagement) variables
- interactions with peers
- interactions with teachers,

CE (cognitive engagement) variables
- valuable learning experiences
- mastery of skills

EE (emotional engagement) variables
- emotional responses,
- interest in science, and
- interesting activities

NP (social positioning) variables
- new actions,
- new perspectives
- teamwork

There are no NT variables in the theoretical model. The resulting framework is reduced from 34 variables to 10 variables.

Quantitative Regression Analysis

A quantitative statistical analysis using multiple regressions and computer software was conducted to see how these 5 engagement and identity components as measured by these 34 variables act together to design a theoretical framework. An overall ECA engagement and identity formation score was calculated for the analyses. A regression equation is sought that can identify the essential components of an ECA in developing a model framework for a science ECA that can account for at least 80% of the variance in engagement and identity. Of the various models and 34 variables examined, the most successful model incorporated only four variables ($F_{(4, 91)} = 101.512$; $\rho = 0.000$) shows a correlation factor, $r = 0.913$. After correcting for interaction factors ($r^2_{adj} = 0.834$), these essential components account for 81.8% of the variance of overall ECA engagement and identity.

A Mixed Model for Engagement and Identity Formation

The four essential factors of this quantitative theoretical model (see Figure 5) are in sharp contrast to the ten variables in the qualitative distillation. These four essential factors reiterate the strong correlation discovered between cognitive engagement and new social positioning and include the following:

<u>CE (cognitive engagement) variables</u>
- valuable learning experiences (CEE)
- mastery of new skills (CEM)

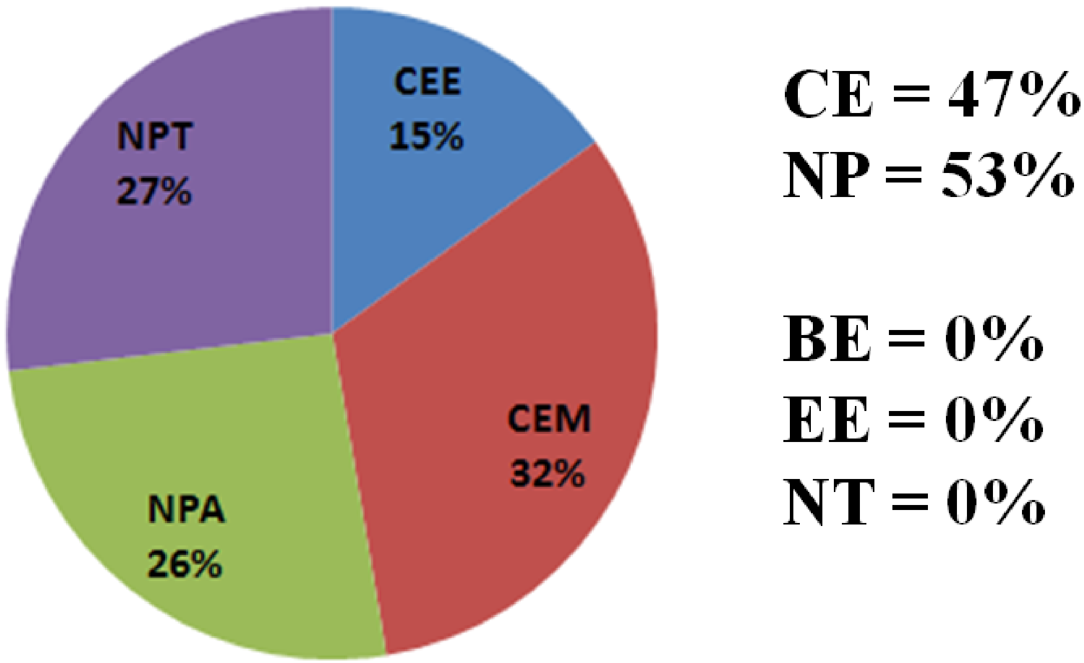
<u>NP (social positioning) variables</u>
- new actions (NPA) and
- teamwork (NPT)

Over 80% of the engagement and identity formation in this study could occur in a science ECA based on cognitive engagement and social positioning. The essential elements of an engaging and socially constructive science ECA is where members perceive they are engaged in valuable learning experiences, mastering new skills and their applications, are engaged in actions through new social positions, and working collaboratively with others toward a common goal. Reading through this definition elicits the image of Habitat for Humanity, an eclectic group of individuals of diverse skills and abilities that converge on a single destination with a single humanitarian purpose in mind, to construct homes for families that would not otherwise be able to afford them.

In this regression configuration, certain factors seem to have been incorporated into others. Working well together (BEW) as well as observing others leading (BEO), working with friends (EEF) and working with new peers (EEN) become subsets of teamwork (NPT). Teacher interactions (BET) and routines (BER) have less significance as well as perspectives (NPP) based on explicit structures dictated by valuable learning experiences. Emotional response (EEE), parent support (EEP) and ties to school (EES) are now embodied in the appeal and intrinsic reward of worthwhile activities and common goals. This altruistic reduction may also be indicative of the adults who completed the survey, rather than the high school students they were when participating in the club.

The benefits of a mixed methods approach become most apparent at this point, for while this quantitative formulation works well on the computer, there is a disconnect with the study's strong qualitative findings of ten variables, particularly since nearly one-third of all the responses on the survey by adults were emotional responses. The breadth and depth of these emotional responses are significant for an ECA design. If adults give one-third emotional responses, the expectation would be that young developing teenagers

Figure 5. Theoretical Mixed Model Based on Engagement and Identity Formation



would have greater emotional responses to the activities in which they participate. Former Whiz Kids intentionally chose to join the club and for very emotional reasons, fun and personal interests. The intrinsic reward of working on something bigger than self as in this model might foster BE persistence bordering on dedication. An ECA built on the variables in this model, however, may lack the emotional appeal needed to attract students initially and it will be the original members who are critical in enlisting others. Using this model, the sponsor would definitely need to “sell it well.”

Evaluation of the Models

Comparing the model using Engagement Only factors (with seven variables) with the Mixed Model (with only four variables) highlights some important qualitative interaction effects. Without the benefit of social positioning and its new actions (NPA), interactions with the teacher (BET) become more critical. Without the collaborative teamwork toward a common goal (NPT), working well together (BEW) becomes a more critical factor. Without these identity components (NPA, NPT), routines and expectations (BER) and activities based on interests (EEI, EEC) become more critical in the model.

However, this quantitative model seems too altruistic to engage students in science based on the important qualitative perceptions also revealed in this study. First, this mixed methods study substantiates that science ECA should address the affective domain and acknowledge the power of emotional engagement to augment the social positions in science that continue to be plagued with perceptions of dull, boring, unexciting people who read books, listen to lectures, and solve hard problems. Second, this model does not encompass the strong impact of teacher-student bonding and relationships, such as those in this study that are still vibrant and responsive, although developed in an ECA 10-25 years ago.

Perhaps science education cannot get kids to the point of designing experiments because it has not hooked them even into simple cause-effect activities well enough to foster their interest in doing higher level, more intricate science experimentation. Perhaps more informal science ECA are needed, to enlist all students in hands-on explorations or inquiry discoveries that intrigue the mind, engage the senses, and make the viewers exclaim at the results, asking, “How does that work?” ECA need to engage students in the wonder of science, e.g., “Is science magic or is magic science?” Science ECA need to make science a verb and have students go ‘sciencing.’ A more realistic, viable, discovery-based, interactive and emotionally-responsive theoretical model for science ECA is needed.

Table 21. Comparison of ECA Models by Holloway, McLaughlin and Irby, Mahoney and Kralina Engagement Only and Mixed Models

Holloway (2002)	McLaughlin & Irby (1994)	Mahoney (2000)	Kralina (2009) Engagement Only	Kralina (2009) Mixed Model
		BEA		
BER	BER	BER		
BET	BET	BET	BET	
BEW	BEW		BEW	
CEC				
	CEE		CEE	CEE
	CEM	CEM	CEM	CEM
	EEA		EEA	
			EEE	
EEI			EEI	
EET	EET			
				NPA
				NPT

Repeated analyses of various combinations, however, only showed plummeting reliability and variance values. In an effort to build on the insights of previous studies, elements of comparable models, as suggested by Holloway (2002), Mahoney (2000), and McLaughlin and Irby (1994) were classified, using the coding schema to check for patterns. Only the factors pertaining to this study could be coded, so personal attributes of student interactions, identified by McLaughlin and Irby (1994) could not be included (see Table 21). Interactions with the teacher (BET) are present in all the models, with half of the models including teacher influence (EET) as well. The Engagement Only Model (Kralina, 2009) contains considerable more emotional engagement variables (EE) than any other model. Both of the two proposed models (Kralina, 2009) lack routines (BER) included by other researchers. CEM and CEE appear significantly in many models. The gap in the literature once again becomes apparent with significant differences occurring with the Mixed Model when social positioning variables were also included.

A Theoretical Enhanced Mixed Model

A better model would be a blend of all qualitative and the quantitative findings. Reconfiguring the regression equation to take into account the impact of emotional engagement variables, a new model is proposed. The most realistic regression model, the Enhanced Mixed Model (see Figure 6) includes seven variables ($F_{(7, 91)} = 94.798$; $\rho = 0.000$) shows a correlation factor, $r = 0.933$. After correcting for interaction factors ($r^2_{adj} = 0.870$), seven essential elements out of the 34 variables measured account for 86.1% of the variance of overall ECA engagement and identity formation in this science ECA, nearly approximating Change Theory proportions as well. The seven essential elements of an engaging and socially constructive science ECA include the following:

<u>BE (behavioral engagement) variables</u>

- interactions with teachers (BET)

<u>CE (cognitive engagement) variables</u>

- valuable learning experiences (CEE)
- mastery of skills (CEM)

<u>EE (emotional engagement) variables</u>

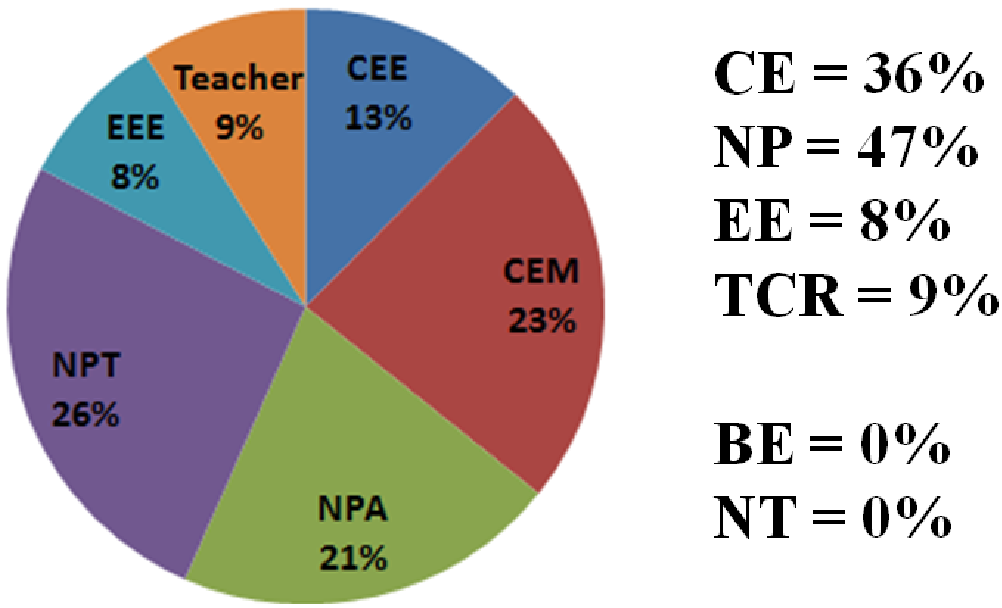
- emotional responses (EEE)
- influence of teacher (EET)

<u>NP (social positioning) variables</u>

- new actions (NPA)
- teamwork (NPT)
-

where teacher interactions and influence are combined (TCHR = BET + EET). Working well together (BEW) has become the more intense collaborative teamwork community

Figure 6. Theoretical Enhanced Mixed Model of Engagement and Identity Formation



(NPT). Since one third of SSWK science club respondents admitted that they did not like science, then interest in science must not be a prerequisite for a science ECA. Interesting activities (EEA) and interests (EEC, EEI) are replaced with new actions through social positioning (NPA), where new learning, experiences and applications occur and complement skill mastery (CEM). Members persist longer and try harder when they view the activities as valuable learning experiences (CEE). Cognitive challenge (CEC) does not need to occur as a separate entity because the challenge is embedded in new actions, teamwork, interesting activities and social learning that is infused throughout the ECA.

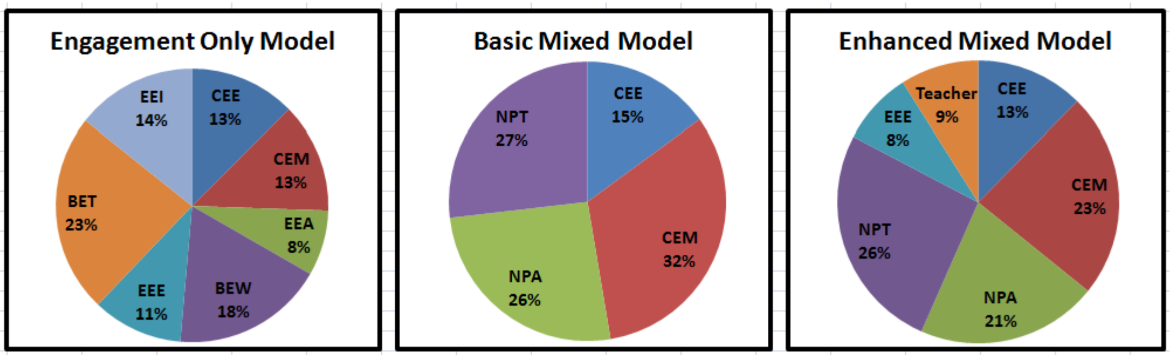
In this model, members would be engaged in enjoyable, worthwhile activities that offered opportunities to develop and master new skills, perhaps role-play through technology. They would be engaged in new actions beyond their regular curricula and would learn new things, experience new ideas and find new applications for concepts covered in their classes. The successful completion or achievement of the club goals and activities would be dependent of an intense cooperative, communicative effort by all members that builds a sense of community among the participants for a job well done. The supervising science teacher provides for the safety of its members during the execution of their activities and the comfortable environment of the club that accepts all members as valuable contributors. While the teacher may provide the initial guidelines, recruit new members, and oversee the club's activities, the members bring their own spirit and creativity to the tasks at hand. The mutual respect and cooperation enhances the relationships between teacher-students and students-students.

In summary, the enhanced mixed model calls for an ECA that is service-oriented, skill-building and appealing to interests (not necessarily science initially) in a low-risk, safe learning environment. This ECA involves more exploratory, hands-on activities and transactive discourse. It encourages peer interactions, promotes cooperation (not competition) and encouragement, provides structure and challenge, and draws in a diverse membership in grade level, race and gender. The enhanced mixed model dictates an ECA that promotes a leisurely (less teacher-controlled) atmosphere through higher teacher-student ratios, yet fosters strong teacher-student relationships. A comparison of all three models showing this model evolution process is shown in Figure 7.

Conclusions

The review of the related literature presented those studies that deal with engagement and those studies that deal with identity formation with little, if any, overlap or corollary findings between them, yet they both seek to understand how students behave, think and feel. Using mixed methods, this study seeks to bridge that gap between engagement studies and identity formation studies by merging and building upon the rich insights from both realms of investigations. By examining ECA from both engagement and identity formation perspectives, a more comprehensive theoretical framework for an engaging and socially constructive science ECA can be designed.

Figure 7. A Comparison of the Three Theoretical Models



The most significant findings of this study are the important role of emotional engagement in science ECA, the high correlation of cognitive engagement with social positioning, the perception roadblocks to science learning and achievement, and the importance of the teacher-student interactions in ECA.

The most significant finding is the high emotional engagement of science ECA participation. The overwhelming reason given for joining a science ECA was for fun, even though one third of the respondents said they hated science. Of over 3900 coded responses in this study, 32% dealt with emotional engagement. The qualitative data offer strong support with emphatic, exclamatory comments and meaningful reflections. It is emotional engagement that draws students to join and participate in ECA. Current competitive science ECA may be meeting the needs of the talented science students but many students were looking for ways to learn science in a more informal, fun environment, to come face-to-face with science at their own level and in the process, they improve their attitudes toward science. This study revealed an untapped population, those NOT interested in science, yet those engaged in an ECA premised solely on science because they perceived the ECA as “fun”. If ‘flow’ is the state of high emotional consciousness that engages us at high levels of concentration and at increasing levels of complexity, then to raise the level of cognitive engagement and complex thinking, science ECA need increased emotional engagement, or ‘flow’. Informal science ECA may be the new model for engaging and social constructive science learning.

Of these findings, the second most significant one is that cognitive engagement is strongly correlated to changes in social positioning. Where most studies cited discuss engagement *or* identity formation, this study has investigated the interaction between these two concepts in order to increase learning. In order for learning to occur, students must be actively engaged, behaviorally, cognitively and emotionally. For changes to occur in the social positioning set by peers, family and school toward new trajectories offering wider educational opportunities and career aspirations, students must be mindfully engaged. Valuable learning experiences and mastery of new skills consistently keep students in ECA. Through their responses, these former students tell us they wanted to learn and they wanted to learn meaningful skills.

Perhaps the greatest finding of this study is that the student perceptions of science which are hindering their learning and achievement can be changed. Changing perceptions may appear as insurmountable as changing social positions, changes that entail becoming an entirely different person. However, changing perceptions for Whiz Kids was done by wearing silly costumes and role-playing as ‘science experts.’ Recognizing that negative science perceptions exist, guide actions, and curtail learning is the first step in correcting this problem. Allowing students to express voice, explore, and experiment in order to change perceptions may be the most critical need and challenge we face in science education today. The depth of these perceptual roadblocks encompasses the nature of science, scientists, and science learning.

Finally, the importance of the teacher-student interactions in ECA is once again validated and evidenced in the strong teacher-student relationships formed in SSWK 10-25 years ago and still strong today. The mutual trust, respect, integrity and caring commitment established with the teacher (EET) facilitates student interactions with the teacher (BET). Combinations using one or the other (BET, EET) reduced reliability and variance by 50%. Particularly in science ECA, experienced, qualified science teachers need to sponsor science ECA to maintain the high standards of science content knowledge as well as to enforce the safety precautions necessary whenever demonstrations take place. Based on respondent comments, qualifications for science ECA sponsors might include being knowledgeable in content, having infinite patience, showing enthusiasm, believing in students, personal commitment, genius, flexibility, dynamism, creativity, devotion and friendliness. They should be a good friend, caring, inviting participation, hard-working , inspiring, able to make science and learning fun, fascinating, empathetic, forgiving, kind, trustworthy, safety-minded, nice, wonderful with children, encouraging, open to suggestions, positive in attitude, relates well with students, super intelligent, skilled, enjoys life, makes student feel valued as if they belong, exciting, willing to help, always available, understanding, role model, etc. Such paragons understandably do not exist in great abundance.

The most comprehensive theoretical framework for an engaging and socially constructive ECA should incorporate seven variables in the proportions shown in Figure 6. The seven variables are teacher interactions and influence (TCHR = BET + EET), valuable learning experiences (CEE), mastery of new skills (CEM), emotional responses (EEE), new actions (NPA), and teamwork (NPT).

Future Studies

Future studies have been noted in several areas. The most predominant one is to construct a science ECA following the precepts of this model and evaluate it for the engagement and identity formation of its members. More direct observations and measurements within such an ECA are needed to supplement this theoretical model constructed currently only from collected memories and archival club records.

Future studies in behavioral engagement include fluctuating time schedules versus weekly meetings; student engagement versus experience and qualifications of science ECA sponsors; time commitment for sports versus exploring potentials through greater variety of ECA; leadership versus time commitments and gender; and leadership opportunities versus cooperative, collaborative working groups.

Additional future studies indicated for cognitive engagement include investigations regarding Bakhtian dialogue and valuable learning experiences; perceptions of science ECA being fun versus perceptions of science not being fun; joining science ECA while affirming aversion to or no interest in science; and ability versus effort controversy in science learning and achievement. Other future studies indicated from this study include inquiry into: spatial visualization skills to improve science learning, particularly for girls; science attitudes versus reasoning skills, the development, implementation and implication of skills that have never been taught; and the benefit of CE (academic achievement) for members who participate in ECA after school versus those that leave the school during the day.

Future studies regarding emotional engagement include the ardor of the teacher/ sponsor for the subject matter versus student engagement (which has not been addressed in this study, but might also prove insightful), changes in attitudes and their impact of engagement, more effective ways and instruments to measure EE, and classroom studies implementing Kahle's (1983) recommendations on ways to encourage girls in science. Future studies may also include voluntary versus compulsory science fair participation, grouping techniques that incorporate interest factors, outside ECA versus classroom activities for attracting more people to science, science ECA in private versus public schools, adolescent versus adult perceptions of science, sources of adolescent perceptions versus parental perceptions, and correlations of attitude changes and emotional engagement.

Future studies in social positioning may include costumes versus non-costumes for changes in social positioning, cognitive and emotional engagement versus behavioral engagement to promote changes in social positioning, and NPI through technology role-playing as an essential element for a socially constructive ECA. Other studies may include the sequencing of the three components of engagement versus social learning, namely, EE and CE, then BE or BE, then CE and EE, and the interaction effects and benefits of engagement and positioning for better learning.

Future studies may include, but are not limited to factors impacting career aspirations and overall trajectory scores; personal reflections to develop value-added ECA and promote girls in science; and displaced trajectories and resulting actions.

References

Abernathy, T. & Vineyard, R. (2001, May/June). Academic competitions in science: What are the rewards for students? *The Clearing House*, *74*(5), 269-276. Retrieved November 2, 2006 from ERIC database.

American Institute for Research (2007, December). TIMSS: Lessons learned from US international science performance. Presentation to the *U.S. Department of Education Policy and Program Studies Services.* Downloaded September 12, 2008 from http://www.air.org/news/documents/lessons.learned.in.science.pdf

Ames, C. & Ames, R. (1984, September). Goal structures and motivation. *The Elementary School Journal 85*, 38-52. Retrieved Abstract October 5, 2008 from Education database.

Anderson, D., Huston, A. & Schmitt, K. (2001). Early childhood television viewing and adolescent behavior: the recontact study. *Monographs of the Society for Research in Child Development*, *66*(1), 1-147. Retrieved December 30, 2006 from ERIC database.

Appelman, R. (2005, May/June). Designing experiential modes: A key focus for immersive learning environments. *TechTrends: Linking Research & Practice to Improve Learning*, 49(3), 64-74. Retrieved September 10, 2008 from Academic Search Premier and Master File database.

Atkinson, P. & Delamont, S. (2006, Spring). Rescuing narrative from qualitative research. *Narrative Inquiry*, *16*(1), 164-172.

Babbie, E. (2001). *The practice of social research* (9th ed.). Belmont: Wadsworth.

Bacharach, V., Baumeister, A. & Furr, M. (2003). Racial and gender science achievement gaps in secondary education. *Journal of Genetic Psychology, 164*(1), 115-126. Retrieved July 25, 2008 from Academic Search Premier and Master File database.

Baker, D., Akiba, M., Le Tendre, G. & Wiseman, A. (2001, Spring). Worldwide shadow education: Outside-school learning, institutional quality of schooling, and cross-national mathematics achievement. *Educational Evaluation and Policy Analysis, 23*(1), 1-17. Retrieved November 5, 2006 from ERIC database.

Baker, D. & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching, 32*(1), 3-28. Provided by Dr. Charles R. Granger for this study.

Bakhtin, M. (1965a). *Rabelais and His World.* Translated by Hélène Iswolsky. Bloomington: Indiana University Press, 1993. In Barrie, R. (2005) Shakespeare and Film (ENG250). Downloaded September 12, 2008 from http://artemis.austin college.edu/acad/english/bbarrie/shakespeare/bakhtin_rab.html

Bakhtin, M. (1965b). *Rabelais and His World.* Translated by Hélène Iswolsky. Bloomington: Indiana University Press, 1993. In Fischer, E. (2006) Culture and Human Nature (ANTH 206). Downloaded September 12, 2008 from http://www.vanderbilt.edu/AnS/Anthro/Anth206/mikhail_bakhtin.htm

Bakhtin, M. (1965c). *Rabelais and His World.* Translated by Hélène Iswolsky. Bloomington: Indiana University Press, 1993. In Washabaugh, W. (2006) The Carnival Model. Downloaded September 12, 2008 from http://www.uwm.edu/~wash/102_18.htm

Bakhtin, M. (1965d). *Rabelais and His World.* Translated by Hélène Iswolsky.

Bloomington: Indiana University Press, 1993. In Zappen, J. (2005) Bibliographies. Downloaded September 12, 2008 from http://www.rpi.edu/~zappenj/Bibliographies/bakhtin.htm

Bakhtin, M. (1986). *Speech Genres and other late essays* (C. Emerson & H. Holquist, Eds.) Austin: University of Texas Press. In Moen, T. (2006, Dec.). Reflections on the narrative research approach. *International Journal of Qualitative Methods, 5*(4), Article 5. Retrieved January 27, 2007 from http://www.ualberta.ca/~ijqm/backissues/5_4/html/moen.htm

Bamberg, M. (2004). Form and functions of "slut bashing" in male identity constructions in 15-year-olds: "I know it may sound mean to say this, but we couldn't really care less about her anyway" *Human Development, 47*(6), p331-353. Retrieved March 17, 2008, from ERIC database.

Barber, B., Eccles, J. & Stone, M. (2001, September). Whatever happened to the jock, the brain, and the princess? Young adult pathways linked to adolescent activity involvement and social identity. *Journal of Adolescent Research, 16*(5), 429-455. Retrieved November 4, 2006 from ERIC database.

Barlow, D. (2007, May). Nerd power. *The Education Digest, 72*(9), 44-7. Retrieved March 13, 2008 from Education database.

Baskin, A. (2005, November). EC: A primer. *Canadian Living, 30*(11), 241-246. Retrieved November 4, 2006 from the ERIC database.

Bell, J. (2001, May). Investigating gender differences in the science performance of 16-year-old pupils in the UK. *International Journal of Science Education, 23*(5), 469-486. Retrieved September 23, 2006 from ERIC database.

Berg, B. (2004). *Qualitative research methods for the social sciences* (5th ed). Upper Saddle River, NJ: Pearson Education, Inc.

Berkowitz, M. & Simmons, P. (2003). Integrating science education and character education: the role of peer discussion. In D. L. Zeidler (Ed.), *Role of moral reasoning on socio-scientific issues and discourse in science education* (pp. 117-138). Netherlands: Kluwer Academic Pub. Retrieved August 30, 2006 from author.

Bidwell, C., Frank, K. & Quiroz, P. (1997). Teacher types, workplace controls, and the organization of schools. *Sociology of Education, 70*(4), 285-307. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Bishop, J., Bishop, M. & Bishop, M. (2004, September). Why we harass nerds and freaks: A formal theory of student culture and norms. *The Journal of School Health, 74*(7), 235-51. Retrieved March 13, 2008 from Education database.

Black, L. (2004). Teacher-pupil talk in whole-class discussions and processes of social positioning within the primary school classroom. *Language & Education: An International Journal, 18*(5), 347-360. Retrieved July 26, 2008 from Academic Search Premier and Master File database.

Blalock, C., Lichtenstein, M., Owen, S., Pruski, L., Marshall, C. & Toepperwein, M. (2008, June 4). In pursuit of validity: A comprehensive review of science attitude instruments 1935-2005. *International Journal of Science Education, 30*(7), 961-977.

Blodgett, L.J., Boyer, W. & Turk, E. (2005, August). "No thank you, not today": Supporting ethical and professional relationships in large qualitative studies.

Forum: Qualitative Social Research, *6*(3), Art 35. Retrieved January 4, 2007 from http://www.qualitative-research.net/fqs-texte/3-05/05-3-35-e.pdf

Blumer, H. (1969). *Symbolic interactionism: Perspective and method.* Englewood Cliffs, NJ: Prentice-Hall. In Berg, B. (2004). *Qualitative research methods for the social sciences* (5th ed), 9. Upper Saddle River, NJ: Pearson Education, Inc.

Bonnstetter, R. (1985, March/April). A science club for the enhancement of learning. *Journal of College Science Teaching, 14*(4), 402-404. Retrieved November 5, 2006 from ERIC database.

Borman, K., LeCompte, M. & Goetz, J. (1986). Ethnographic and qualitative research and design and why it doesn't work. In Berg, B. (2004). *Qualitative research methods for the social sciences* (5th ed). Upper Saddle River, NJ: Pearson Education, Inc.

Bower, B. (2004, June 19). Tuning up young minds. *Science News, 165*(25), 389-389. Retrieved November 5, 2006 from ERIC database.

Bradburn, N., Sudman, S., et al (1981). *Improving interview method and questionnaire design.* San Francisco: Jossey-Bass. In Gall, M., Gall, J. & Borg, W. (2007). *Educational research: An introduction* (8th ed.), p. 253. Boston, MA: Pearson.

Broh, B. (2002, January). Linking extracurricular programming to academic achievement: Who benefits and why? *Sociology of Education, 75*(1), 69-95. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Brown, B. (1988, Spring). The vital agenda for research on extracurricular influences: A reply to Holland and Andre. *Review of Educational Research, 58*(1), 107-111. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Brown, J. S. (2006, September/October). New learning environments for the 21st century: Exploring the edge. *Change, 38*(5), 18-24. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Bruer, J. T. (1993). *Schools for thought: A science of learning in the classroom*. Cambridge, MA: MIT Press.

Bruner, J. (1990). *Acts of Meaning.* Cambridge, MA: Harvard University Press.

Burian-Fitzgerald, M. & Harris, D. (2004, December). Giving 110%: A portrait of a Michigan teacher's work week. *Education Policy Center Policy Report Number 22*, Michigan State University; 1-8. Retrieved August 8, 2008 from the ERIC database.

Caldwell, L. & Darling, N., (1999). Leisure context, parental control, and resistance to peer pressure as predictors of adolescent partying and substance use: An ecological perspective. *Journal of Leisure Research, 31*, 57-77. Retrieved December 30, 2006 from Academic Search Premier and Master File database.

Camp, W. (1990, May/June). Participation in student activities and achievement: A covariance structural analysis. *Journal of Educational Research, 83*(5), 272-282. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Campbell, P. & Clewell, B. (1999, September 15). Science, math, and girls...still a long way to go. *Education Week, 19*(2), 50-52. Retrieved July 17, 2008 from Academic Search Premier and Master File database.

Cereijo, M., Tyler-Wood, T. & Young, J. (2002, October). Minimizing the gender equity gap in science and technology. Presentation at E-Learn '02: *E-Learning in Corporate, Government, Healthcare, & Higher Education*. Proceedings (7th, Montreal, Quebec, Canada, October 15-19, 2002); see IR 022 093. Retrieved Abstract October 26, 2006 from ERIC database.

Chambers, E. & Schreiber, J. (2004, September). Girls' academic achievement: varying associations of extracurricular activities. *Gender and Education*, *16*(3), 327-347. Retrieved December 28, 2006 from ERIC database.

Chenail, R. (1995). Presenting qualitative data. The Qualitative Report, 2*(3), 1-8. Retrieved January 7, 2007 from* www.nova.edu/ssss/QR/QR2-3/presenting.html

Chinn, P. & Iding, M. (1997, Spring). High school chemistry students' self-concepts as writers and scientists. *Teaching and Change, 4*(3), 227-44. Retrieved October 26, 2006 from ERIC database.

Chinouth, S. (1994, February). Mega learning for mini bucks. *Science Scope, 17*(5), 20-22. Retrieved November 3, 2006 from ERIC database.

Cloud, J., Badowski, C., Rubiner, B. & Scully, S. (2004, September 27). Saving the smart kids. *Time Canada, 164*(13), 44-49. Retrieved August 8, 2008 from Academic Search Premier and Master File database.

Colwell, B. (2005, July). Judging science fairs. *Computer, 38*(7), p12-15. Retrieved August 6, 2008 from Academic Search Premier and Master File database.

Cooper, H., Valentine, J., Nye, B. & Lindsay, J. (1999, June). Relationships between five after-school activities and academic achievement. *Journal of Educational Psychology, 91*(2), 369-378. Retrieved December 2, 2006 from Academic Search Premier and Master File database.

Crawley, P. (1998, March). Extracurricular opportunities. *Science Teacher*, *65*(3), 37-38. Retrieved December 28, 2006 from ERIC database.

Creswell, J.W. (2003). *Research design. Qualitative, quantitative, and mixed methods approaches* (2nd ed). Thousand Oaks, CA: Sage

Crosnoe, R., Johnson, M. & Elder, G. (2004). School size and the interpersonal side of education: An examination of race/ethnicity and organizational context. *Social Science Quarterly*, *85*(5), 1259-1274. Retrieved December 6, 2006 from Academic Search Premier and Master File database.

Cross, T. (2005). Nerds and geeks: Society's evolving stereotypes of our students with gifts and talents. *Gifted Child Today*, *28*(4), p. 26-7, 65. Retrieved September 12, 2008 from Education database.

Csikzentmihalyi, M. (1988). The flow experience and its significance for human psychology. In Fredricks, J., Blumenfeld, P. & Paris, A. (2004, Spring). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59-109. Retrieved August 6, 2008 from Academic Search Premier and Master File database.

Csikzentmihalyi, M. (1999, October). If we are so rich, why aren't we happy? *American Psychologist*, *54*(10), 821-828. Retrieved October 1, 2008 from Academic Search Premier and Master File database.

Currie, D., Kelly, D. & Pomerantz, S. (2007, July). Listening to girls: Discursive positioning and the construction of self. *International Journal of Qualitative Studies in Education, 20*(4), 377-400. Retrieved March 17, 2008 from ERIC

database.
Currie, G. (1991, April). Visual fictions. *Philosophical Quarterly, 41*(163), 129-144. Retrieved December 12, 2006 from Academic Search Premier and Master File database.
Cushman, K. (2006, February). Help us care enough to learn. *Educational Leadership, 63*(5), 34-37. Retrieved August 4, 2008 from Academic Search Premier and Master File database.
Darling, N., Caldwell, L. & Smith, R. (2005, 1st Quarter). Participation in school-based ECA and adolescent adjustment. *Journal of Leisure Research, 37*(1), 51-76. Retrieved November 20, 2006 from Academic Search Premier and Master File database.
Davis-Maye, D. (2004, March). Daddy's little girl. *Journal of Children & Poverty, 10*(1), 53-68. Retrieved September 23, 2006 from Academic Search Premier and Master File database.
Day, L., Langbort, C. & Skolnick, J. (1982). *How to encourage girls in math and science.* Palo Alto, CA: Dale Seymour Pub.
Debacker, T. & Nelson, R. (2000, March/April). Motivation to learn science: Differences related to gender, class type, and ability. *Journal of Educational Research, 93*(4), 245-255. Retrieved September 23, 2006 from Academic Search Premier and Master File database.
Dewey, J. (1916). *Education and democracy*. New York: Macmillan Co.
Dickey, M. (2003, May). Teaching in 3D: Pedagogical affordances and constraints of 3D virtual worlds for synchronous distance learning. *Distance Education, 24*(1), 105-122. Retrieved September 10, 2008 from Academic Search Premier and Master File database.
Dison, A. (2004, December). "Finding her own academic self": Research capacity development and identity formation. *Perspectives in Education, 22*(4), p83-98. Retrieved March 17, 2008 from ERIC database.
Dunkelberger, G. (1935, December). Do ECA make for poor scholarships? *Journal of Educational Sociology, 9*(4), 215-218. Retrieved November 30, 2006 from Academic Search Premier and Master File database.
Dworkin, J., Larson, R. & Hansen, D. (2003, February). Adolescent's accounts of growth experiences in youth activities. *Journal of Youth and Adolescence, 32*(1), 17-27. Retrieved December 2, 2006 from Academic Search Premier and Master File database.
Dyer, S. (2004). Under the microscope: A decade of gender equity projects in the sciences. Evaluative Report for *American Association of University Women Educational Foundation*. Retrieved July 18, 2008 from ERIC database.
Easton, K., McComish, J. & Greenberg, R. (2000, Sept.). Avoiding common pitfalls in qualitative data collection and transcription. *Qualitative Health Research, 10*(5), 703-707.
Eccles, J. & Barber, B (1999, January). Student council, volunteering, basketball, or marching band: What kind of extracurricular involvement matters? *Journal of Adolescent Research, 14*(1), 10-44. Retrieved November 5, 2006 from Academic Search Premier and Master File database.
Eccles, J., Barber, B., Stone, M. & Hunt, J. (2003, December). Extracurricular activities

and adolescent development. *Journal of Social Issues, 59*(4), 865-890. Retrieved December 3, 2006 from Academic Search Premier and Master File database.

Eccles, J. & Early, D. (1997). The relation of connection, regulation, and support for autonomy to adolescents' functioning. *Journal of Adolescent Research, 12*(2), 263-286. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Eckert, P. (1989). Jocks and burnouts jocks & burnouts: Social categories and identity in the high school. New York: Teachers College Press.

Eder, D. & Parker, S. (1987, July). The cultural production and reproduction of gender: The effect of extracurricular activities on peer group culture. *Sociology of Education*, *60*(3), 200-213. Retrieved November 13, 2006 from ERIC database.

Educational Research Service (1989). Extra pay for extra duties of teachers. Arlington, VA.: *ERS Report* ED311551, 1-71. Retrieved August 8, 2008 from the ERIC database.

Ellis, R. S. (1993, December). Impacting the science attitudes of minority high school youth. *School Science and Mathematics, 93*(8), 400-407. Retrieved Abstract August 2, 2008 from ERIC database.

Everson, H. & Millsap, R. (2004, Summer). Beyond individual differences: Exploring school effects on SAT scores. *Educational Psychologist, 39*(3), 157-172. Retrieved March 4, 2008 from Academic Search Premier and Master File database.

Eylon, B., Hofstein, A., Maoz, N. & Rishpon, M. (1985). Extra-curricular science courses: Filling a gap in school science education. *Research in Science and Technological Education, 3*(1), 81-89. Retrieved November 5, 2006 from ERIC database.

Fairbanks, C. & Ariail, M. (2006, February). The role of social and cultural resources in literacy and schooling: Three contrasting cases. *Research in the Teaching of English*, *40*(3), 310-354. Retrieved March 17, 2008 from ERIC database.

Feinstein, S. (2001, January 29). Bring it on. *Newsweek*, *137*(5), 55. Retrieved November 6, 2006 from Academic Search Premier and Master File database.

Feldman, A. & Matjasko, J. (2005, Summer). The role of school-based ECA in adolescent development: A comprehensive review and future directions. *Review of Educational Research*, *75*(2), 159-210. Retrieved November 8, 2006 from ERIC database.

Field, J. & Olafson, L. (1999, Winter). Caught in the machine: Resistance, positioning, and pedagogy. *Research in Middle Level Education Quarterly*, *22*(2) 39-55. Retrieved October 6, 2008 from ERIC database.

Fisher, L. (2005, November). Pride and parenting. *Health*, *19*(9), 150-150. Retrieved November 6, 2006 from Academic Search Premier and Master File database.

Fisher, R. & Ackerman, D. (1998). The effects of recognition and group need on volunteerism: a social norm perspective. *The Journal of Consumer Research, 25*(3), 262-275. Retrieved August 9, 2008 from Academic Search Premier and Master File database.

Flick, U. (2006). *An introduction to qualitative research* (third edition). Thousand Oaks, CA: Sage.

Flinders, D. (1992). In search of ethical guidance: Constructing a base for dialogue.

International Journal of Qualitative Studies in Education, 5, 101-115. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 459-460. Boston, MA: Pearson.

Fredricks, J. & Eccles, J. (2006, July). Extracurricular involvement and adolescent adjustment: impact of duration, number of activities, and breadth of participation. *Applied Developmental Science, 10*(3), 132-146. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Fredricks, J., Alfred-Liro, C., Hruda, L., Eccles, J., Patrick, H. & Ruan, A. (2002, January). A qualitative exploration of adolescents' commitment to athletics and the arts. *Journal of Adolescent Research, 17*(1), 68-97. Retrieved November 5, 2006 from Academic Search Premier and Master File database.

Fredricks, J., Blumenfeld, P. & Paris, A. (2004, Spring). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59-109. Retrieved August 6, 2008 from Academic Search Premier and Master File database.

Fredricks, J. & Eccles, J. (2006, July). Extracurricular involvement and adolescent adjustment: Impact of duration, number of activities and breadth of participation. *Applied Developmental Science, 10*(3), 132-146. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Gall, M., Gall, J. & Borg, W. (2007). *Educational research: An introduction* (8th ed.). Boston, MA: Pearson.

Gee, J. P. (2002) *An introduction to discourse analysis: Theory and methods.* London: Routledge. In Currie, D., Kelly, D. & Pomerantz, S. (2007, July). Listening to girls: Discursive positioning and the construction of self. *International Journal of Qualitative Studies in Education, 20*(4), 377-378. Retrieved March 17, 2008 from ERIC database.

Gerber, S. (1996). ECA and academic achievement. *Journal of Research and Development in Education, 30*(1), 42-50. Retrieved November 5, 2006 from ERIC database.

Gibson, J. J. (1977). The theory of affordances. In R. Shaw & J. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology (pp. 67–82). Hillsdale, NJ: Erlbaum Associates. In Dickey, M. (2003, May). Teaching in 3D: Pedagogical affordances and constraints of 3D virtual worlds for synchronous distance learning. *Distance Education, 24*(1), 105-122. Retrieved September 10, 2008 from Academic Search Premier and Master File database.

Gifford, V. & Dean, M. (1990, Winter). Differences in extracurricular activity participation, achievement, and attitudes toward school. *Adolescence, 25*(100), 799-803. Retrieved August 6, 2006 from Academic Search Premier and Master File database.

Gilbert, J. (2001, Sept.). Science and its 'other': Looking underneath 'woman' and 'science' for new directions in research on gender and science education. *Gender & Education, 13*(3), 291-305. Retrieved July 25, 2008 from Academic Search Premier and Master File database.

Gillibrand, E., Robinson, P., Brawn, R. & Osborn, A. (1999, April). Girls' participation in physics in single sex classes in mixed schools in relation to confidence and achievement. *International Journal of Science Education, 21*(4), 350-364.

Retrieved September 23, 2006 from Academic Search Premier and Master File database.

Gilman, R., Meyers, J. & Perez, L. (2004, January). Structured extracurricular activities among adolescents: findings and implications for school psychologists. *Psychology in the Schools, 41*(1), 31-41. Retrieved August 4, 2008 from ERIC database.

Gilpin, L. (2005, Spring). Storying and de-storying black teacher identities. *Teacher Education and Practice, 18*(2), 215-230. Retrieved March 17, 2008 from ERIC database.

Giroux, H. (1994, Fall). Doing cultural studies: Youth and the challenge of pedagogy. *Harvard Educational Review, 64*, 278-308. Retrieved Abstract March 17, 2008 from Education database.

Goldberg, H., Haase, E., Shoukas, A. & Schramm L. (2006). Redefining classroom instruction. *Advances in Physiology Education, 30*(1-4), 124-127. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Guest, A. & Schneider, B. (2003, April). Adolescents' extracurricular participation in context: The mediating effects of schools, communities, and identity. *Sociology of Education, 76*(2), 89-109. Retrieved November 5, 2006 from ERIC database.

Guest, G., Bunce, A. & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods, 18(1),* 59-82.

Habermas, J. (1984). The theory of communicative action I. Reason and the rationalization of society (trans. Thomas McCarthy). Cambridge: Polity Press. In Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action, 9.* Cambridge, MA: Harvard University Press.

Hadjistavropoulos, T. & Smythe, W. (2001). Elements of risk in qualitative research. *Ethics and Behavior, 11*(2), 163-175. Retrieved November 14, 2006 from Academic Search Premier and Master File database.

Hammrich, P., Richardson, G. & Livingston, B. (2000, Fall). Sisters in science: Teachers' reflective dialogue on confronting the gender gap. *Journal of Elementary Science Education, 12*(2), 39-52. Retrieved September 26, 2006 from ERIC database.

Handel, R. (1986). Achievement attitudes in mathematics and science: relationships between self-perceptions, aspirations, and extra-curricular activities. Presentation at AERA ’86: *American Educational Research Association*. San Francisco, CA. Retrieved October 27, 2006 from ERIC database.

Hanks, M. (1981). Youth, voluntary associations and political socialization. *Social Forces, 60*(1), 211-223. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Hanks, M. & Eckland, B. (1978, Summer). Adult voluntary associations and adolescent socialization. *Sociological Quarterly, 19*(3), 481-490. Retrieved July 26, 2008 from Academic Search Premier and Master File database.

Hansen, D., Larson, R. & Dworkin, J. (2003, March). What adolescents learn in organized youth activities: A survey of self-reported developmental experiences. *Journal of Research on Adolescence, 13*(1), 25-55. Retrieved December 2, 2006 from Academic Search Premier and Master File database.

Hansen, D., Larson, R. & Moneta, G. (2006, September). Differing profiles of developmental experiences across types of organized youth activities. *Developmental Psychology, 42*(5), 849-863. Retrieved December 31, 2006 from Academic Search Premier and Master File database.

Hanson, S. & Kraus, R. (1998, April). Women, sports, and science: Do female athletes have an advantage? *Sociology of Education, 71*(2), 93-110. Retrieved November 30, 2006 from ERIC database.

Harragan, B. (1977). *Games mother never taught you*. New York, NY: Warner Books.

Harrison, P. & Narayan, G. (2003, March). Differences in behavior, psychological factors, and environmental factors associated with participation in school sports and other activities in adolescence. *Journal of School Health, 73*(3), 113-20. Retrieved November 8, 2006 from ERIC database.

Hart, D. (2005). The development of moral identity. *Nebraska Symposium on Motivation, 51,* 165-196. Retrieved November 5, 2006 from ERIC database.

Haussler, P. & Hoffmann, L. (2002, November). An intervention study to enhance girls' interest, self-concept, and achievement in physics classes. *Journal of Research in Science Teaching, 39*(9), 870-88. Retrieved August 7, 2008 from the ERIC database.

Herman, M. (1997). Crowds, clubs and tracks: How overlapping group membership and consistent group values affect the links between domains of adolescent achievement. Presentation at ASA ’97: *American Sociological Association*. Abstract retrieved December 26, 2006 from ERIC database.

Hessler, R., Downing, J., Beltz, C., Pelliccio, A., Powell, M. & Vale, W. (2003, Spring). Qualitative research on adolescent risk using e-mail: A methodological assessment. *Qualitative Sociology, 26*(1), 111-125.

Hill, F. & Taylor, T. (1992, January). Connecting your club and classroom. *Science Teacher, 59*(1), 18-21. Retrieved November 2, 2006 from ERIC database.

Hirsch, B. (2005). A place to call home: after-school programs for urban youth. New York, NY: Teachers College Press.

Hoffman, J. (2006, September). ECA, athletic participation, and adolescent alcohol use: Gender differentiated and school-contextual effects. *Journal of Health and Social Behavior, 47*(3), 275-290. Retrieved November 8, 2006 from Academic Search Premier and Master File database.

Hoffmann, L. (2002, August). Promoting girls' interest and achievement in physics classes for beginners. *Learning & Instruction, 12*(4), 447-466. Retrieved August 7, 2008 from Academic Search Premier and Master File database.

Hofstein, A., Maoz, N. & Rishpon, M. (1990, January). Attitudes toward school science: A comparison of participants and non-participants in extracurricular science activities. *School Science and Mathematics, 90*(1), 13-22. Retrieved Abstract November 5, 2006 from ERIC database.

Holland, A. & Andre, T. (1987, Winter). The effects of participation in extracurricular activities in secondary school: What is known, what needs to be known? *Review of Educational Research, 57*(4), 437-466. Retrieved November 30, 2006 from ERIC database.

Holloway, J. (2002, September). Extracurricular activities and student motivation. *Educational Leadership, 60*(1), 80-81. Retrieved August 8, 2008 from ERIC database.

Hossler, D. & Stage, F. (1992). Family and high school experience influences on the postsecondary educational plans of ninth grade students. *American Educational Research Journal, 29*(2), 425-451. Retrieved November 30, 2006 from ERIC database.

House, D. (2000, April). The effect of student involvement on the development of academic self-concept. *Journal of Social Psychology, 140*(2), 261-263. Retrieved November 3, 2006 from Academic Search Premier and Master File database.

Howes, E. (2002). *Connecting girls and science: Constructivism, feminism, and science education reform. Ways of knowing in science and mathematics series.* New York, NY: Teachers College Press

Hoyle, R. (2008). What is self? Posting for *International Society for Self and Identity*. Downloaded September 30, 2008 from http://www.psych.neu.edu/ISSI/daily.htm

Hunt, H. (2005, Jul/August). The effect of extracurricular activities in the educational process: Influence on academic outcomes? *Sociological Spectrum*, *25*(4), 417-445. Retrieved Abstract December 28, 2006 from Academic Search Premier and Master File database.

Hupcey, J. E. (2002). Maintaining validity: The development of the concept of trust. *International Journal of Qualitative Methods, 1*(4). Article 5. Retrieved January 7, 2007 from http://www.ualberta.ca/~ijqm

Huppert, J., Lomask, S. & Lazarowitz, R. (2002, August). Computer simulations in the high school: Students' cognitive stages, science process skills and academic achievement in microbiology. *International Journal of Science Education, 24*(8), 803-821. Retrieved September 23, 2006 from ERIC database.

Jacobs, J., Finken, L., Griffin, N. & Wright, J. (1998, Winter). Career plans of science-talented rural adolescent girls. *American Educational Research Journal*, *35*(4), 681-704. Retrieved October 26, 2006 from ERIC database.

Jacobs, J., Vernon, M. & Eccles, J. (2004, January). Relations between social self-perceptions, time use, and pro-social or problem behaviors during adolescence. *Journal of Adolescent Research, 19*(1), 45-62. Retrieved Abstract December 5, 2006 from Academic Search Premier and Master File database.

Janoski, T., Musick, M. & Wilson, J. (1998, September). Being volunteered? The impact of social participation and pro-social attitudes on volunteering. *Sociological Forum*, *13*(3), 495-519. Retrieved November 30, 2006 from ERIC database.

Jodl, K., Michael, A., Malanchuk, O., Eccles, J. & Sameroff, A. (2001, July). Parents' roles in shaping early adolescents' occupational aspirations. *Child Development, 72*(4), 1247-1267. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Jones, G. (1991, April). Gender differences in science competitions. *Science Education, 75*(2), 159-67. Retrieved November 17, 2006 from ERIC database.

Jussim, L. & Eccles, J. (1992, December). Teacher expectations II: Construction and reflection of student achievement. *Journal of Personality & Social Psychology, 63*(6), 947-961. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Kahle, J. (1983, October 14). Factors affecting the retention of girls in science courses & careers: case studies of selected secondary schools, 1-40. Report to *National Science Foundation, National Science Board Commission on Precollege*

Education in Mathematics, Science and Technology. Retrieved November 4, 2006 from ERIC database.

Kahle, J. (1989, December). Images of scientists: Gender issues in science classrooms. *What Research Says to the Science and Mathematics Teacher, 4*, 1-9. Retrieved November 4, 2006, from ERIC database.

Kahle, J. & Lakes, M. (1983, February). The myth of equality in science classrooms. *Journal of Research in Science Teaching*, *20*(2), 131-140. Retrieved November 4, 2006 from ERIC database.

Kahle, J., Matyas, M. & Cho, H. (1985, May). An assessment of the impact of science experiences on the career choices of male and female biology students. *Journal of Research in Science Teaching*, *22*(5), 385-94. Retrieved October 27, 2006 from ERIC database.

Kahle, J. & Meece, J. L. (1994). Research on gender issues in the classroom. In D. Gable (Ed.), *Handbook of research on science teaching and learning*, 542-557. New York: Macmillan.

Kahle, J., Parker, L., Rennie, L. & Riley, D. (1993). Gender differences in science education: Building a model. *Educational Psychology, 28*(4), 379-404. Retrieved November 6, 2006 from ERIC database.

Kao, G. (2000, September). Group images and possible selves among adolescents: Linking stereotypes to expectations by race and ethnicity. *Sociological Forum, 15*(3), 407-430. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Kaser, J. (1980, June). *Sex equity beyond the classroom door: Title IX and extracurricular activities. A technical manual.* Washington DC: Department of Education Report ED199482,104. Retrieved August 8, 2008 from ERIC database.

Kennedy, H. & Parks, J. (2000, Spring). Society cannot continue to exclude women from the fields of science and mathematics. *Education*, *120*(3), 529-538. Retrieved September 23, 2006 from ERIC database.

Kerr, B. & Robinson-Kurpius, S. E. (2004). Encouraging talented girls in math and science: Effects of a guidance intervention. *High Ability Studies, 15*(1), 85-102. Retrieved October 26, 2006 from ERIC database.

Kessels, U. (2005, September). Fitting into the stereotype: How gender-stereotyped perceptions of prototypic peers relate to liking for school subjects. *European Journal of Psychology of Education - EJPE, 20*(3), 309-323. Retrieved September 23, 2006 from Academic Search Premier and Master File database.

Kinney, D. (1993, January). From nerds to normals: The recovery of identity among adolescents from middle school to high school. *Sociology of Education, 66*(1), 21-40. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Kirk, J. & Miller, M. (1986). *Reliability and validity in qualitative research.* Thousand Oaks, CA: Sage. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 449. Boston, MA: Pearson.

Kisiel, J. (2006, September). Urban teens exploring museums: Science experiences beyond the classroom. *The American Biology Teacher, 68*(7), 396, 398-9, 401. Retrieved December 31, 2006 from Education database.

Klein, J. (2004, Summer). Who is most responsible for gender differences in scholastic achievements: pupils or teachers? *Educational Research, 46*(2), 183-193. Retrieved September 23, 2006 from Academic Search Premier and Master File database.

Kohlbacher, F. (2005, December). The use of qualitative content analysis in case study research. *Forum: Qualitative Social Research, 7*(1), Art. 21. Retrieved January 10, 2007 from http://www.qualitative-research.net/fqs-texte/1-06/06-1-21-e.pdf

Korpan, C., Bisanz, G., Bisanz, J., Boehme, C. & Lynch, M. (1997, November). What did you learn outside of school today? Using structured interviews to document home and community activities related to science and technology. *Science Education, 81*(6), 651-662. Retrieved August 2, 2008 from ERIC database.

Koszalka, T., Grabowski, B. & Darling, N. (2005, March). Predictive relationships between web and human resource use and middle school students' interest in science careers: An exploratory analysis. *Journal of Career Development*, *31*(3), 171-184. Retrieved October 27, 2006 from ERIC database.

Koutsoulis, M. & Campbell, J. (2001). Family processes affect students' motivation, and science and math achievement in Cypriot high schools. *Structural Equation Modeling, 8*(1), 108-127. Retrieved March 6, 2007 from Academic Search Premier and Master File database.

Kralina, Linda M. (1989, February). Meet Suzy Science and the Whiz Kids. *Science Teacher, 56*(2), 60-61.

Kreischer, R. (1998). An educational odyssey. *Independent School, 58*(2), 80-87. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Landers, D. & Landers, D. (1978). Socialization via interscholastic athletics: Its effects on delinquency. *Sociology of Education, 51*(4), 299-303. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Larose, S., Ratelle, C., Guay, F., Senécal, C. & Harvey, M. (2006, August). Trajectories of science self-efficacy beliefs during the college transition and academic and vocational adjustment in science and technology programs. *Educational Research & Evaluation, 12*(4), 373-393. Retrieved January 24, 2007 from Academic Search Premier and Master File database.

Lawton, C. & Bordens, K. (1995, March). Gender differences in science interests: An analysis of science fair projects. Presentation at SRCD ’95: *Society for Research in Child Development*. Indianapolis, IN. Retrieved November 7, 2006 from the ERIC database.

Lemke, J. (2000). Across the scales of time: Artifacts, activities, and meanings in ecosocial systems. *Mind, Culture & Activity, 7*(4), 273-290. Retrieved September 10, 2008 from Academic Search Premier and Master File database.

Lennart, N. (2001, Dec). Analysis of short reflective narratives: A method for the study of knowledge in social workers’ actions. *Qualitative Research, 1*(3), 369-384.

Lerner, A. & Lowe, F. (1954). *Brigadoon* [Motion Picture]. United States: MGM Pictures.

Lindsay, P. (1984, Spring). High school size, participation in activities, and young adult social participation: Some enduring effects of schooling. *Educational Evaluation and Policy Analysis, 6*(1), 73-83. Retrieved November 30, 2006 from ERIC

database.
Lupart, J., Cannon, E. & Telfer, J. A. (2004). Gender differences in adolescent academic achievement, interests, values and life-role expectations. *High Ability Studies, 15*(1), 25-42. Retrieved October 27, 2006 from ERIC database.
Luthar, S., Shoum, K. & Brown, P. (2006, May). Extracurricular involvement among affluent youth: a scapegoat for "ubiquitous achievement pressures"? *Developmental Psychology, 42*(3), 583-97. Retrieved December 31, 2006 from Education database.
MacLean, L., Meyer, M. & Estable, A. (2004, January) Improving accuracy of transcripts in qualitative research. *Qualitative Health Research, 14*(1), 113-123.
Mahar, D. (2001, November). Positioning in a middle school culture: gender, race, social class, and power. *Journal of Adolescent & Adult Literacy, 45*(3), 200-9. Retrieved March 17, 2008 from Education database.
Mahoney, J. (2000, March). School extracurricular activity participation as a moderator in the development of antisocial patterns. *Child Development, 71*(2), 502-516. Retrieved August 4, 2008 from ERIC database.
Mahoney, J. & Cairns, R. (1997). Do extracurricular activities protect against early school dropout? *Developmental Psychology, 33*, 241-253. Retrieved August 6, 2008 from ERIC database.
Mahoney, J., Cairns, B. & Farmer, T. (2003, June). Promoting interpersonal competence and educational success through extracurricular activity participation. *Journal of Educational Psychology, 95*(2), 409-418. Retrieved August 6, 2008 from ERIC database.
Mahoney, J. & Stattin, H. (2000, April). Leisure activities and adolescent antisocial behavior: The role of structure and social context. *Journal of Adolescence, 23*(2), p113-128. Retrieved November 20, 2006 from Academic Search Premier and Master File database.
Mahoney, J., Stattin, H. & Magnusson, D. (2001). Youth recreation centre participation and criminal offending: A 20-year longitudinal study of Swedish boys. *International Journal of Behavioral Development, 25*(6), 509-520. Retrieved December 2, 2006 from Academic Search Premier and Master File database.
Markowitz, D. (2004, September). Evaluation of the long-term impact of a university high school summer science program on students' interest and perceived abilities in science. *Journal of Science Education & Technology, 13*(3), 395-407. Retrieved July 17, 2008 from Academic Search Premier and Master File database.
Marsh, H. (1992, December). Extracurricular activities: Beneficial extension of the traditional curriculum or subversion of academic goals? *Journal of Educational Psychology, 84*, 553-562. Retrieved December 28, 2006 from Academic Search Premier and Master File database.
Marsh, H. & Kleitman, S. (2002). Extracurricular school activities: The good, the bad, and the nonlinear. *Harvard Educational Review, 72,* 464-514. Retrieved July 17, 2008 from Academic Search Premier and Master File database.
Mason, C. & Kahle, J. (1989, January). Student attitudes toward science and science-related careers: A program designed to promote a stimulating gender-free learning environment. *Journal of Research in Science Teaching, 26*(1), 25-39. Retrieved Abstract November 8, 2006 from the ERIC database.

Maxwell, J. (2005). *Qualitative research design: An interactive approach* (2nd ed.). Thousand Oaks, CA: Sage. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 454, 474-476. Boston, MA: Pearson.

Mayring, P. (2000, June). Qualitative content analysis. *Forum: Qualitative Social Research [On-line Journal], 1*(2). Retrieved January 8, 2007 from http://www.qualitative-research.net/fqs-texte/2-00/2-00mayring-e.pdf

McCarthy, E. (2006, November 16). Test scores could spell long-term shortages for national security. *Popular Mechanics Online Magazine.* Downloaded September 12, 2008 from http://www.popularmechanics.com/blogs/science_news/4202336.html

McCormack, A., (1990). *Magic and showmanship for teachers.* Riverview, FL: Idea Factory.

McKinstry, P. (1988, October). Join the club. *Science Teacher, 55*(7), 41-42. Retrieved November 5, 2006 from ERIC database.

McLaughlin, M. & Irby, M. (1994, December). Urban sanctuaries: Neighborhood organizations that keep hope alive. *Phi Delta Kappan, 76*(4), 300-06. Retrieved December 26, 2006 from ERIC database.

McLellan, E., MacQueen, K. & Neidig, J. (2003, February). Beyond the qualitative interview: Data preparation & transcription. *Field Methods, 15*(1), 63–84.

McLure, G. & McLure, J. (2000, May). Science course taking, out-of-class science accomplishments, and achievement in the high school graduating class of 1998. Research report series. *American Coll. Testing Program Report* (ACT-RR-2000-5), 1-56. Retrieved December 28, 2006 from ERIC database.

McManis, Sam (2003, July 13). Breaking the 'boy code': New movement advocates adapting schools and society to what works for boys. *San Francisco Chronicle*, p. E-2. Downloaded October 4, 2008 from http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2003/07/13/LV265081.DTL

McNeal, R. (1995, January). ECA and high school dropouts. *Sociology of Education, 68*(1), 62-81. Retrieved November 9, 2006 from ERIC database.

McNeal, R. (1998, Jan-Feb). High school EC: Closed structures and stratifying patterns of participation. *Journal of Educational Research, 91*(3), 183-191. Retrieved November 4, 2006 from ERIC database.

McNeal, R. (1999, June). Participation in high school EC: Investigating school effects. *Social Science Quarterly, 80*(2), 291-309. Retrieved November 2, 2006 from ERIC database.

McNeely, C., Nonnemaker, J. & Blum, R. (2002, April). Promoting school connectedness: Evidence from the National Longitudinal Study of Adolescent Health. *Journal of School Health, 72*(4), 138-147. Retrieved December 5, 2006 from Academic Search Premier and Master File database.

Merriam, S. (1998). *Qualitative Research and Case Study Applications in Education* (second edition). San Francisco: Jossey-Bass.

Miller, L., Lietz, P. & Kotte, D. (2002, April). On decreasing gender differences and attitudinal changes: Factors influencing Australian and English pupils' choice of a career in science. *Psychology, Evolution & Gender, 4*(1), 69-92. Retrieved November 30, 2006 from ERIC database.

Mji, A. & Mbinda, Z. (2005, August). Exploring high school science students' perceptions of parental involvement in their education. *Psychological Reports, 92*(1), 325-336. Retrieved November 6, 2006 from Academic Search Premier and Master File database.

Mo, Y. & Singh, K. (2008). Parents' relationships and involvement: Effects on students' school engagement and performance. *Research in Middle Level Education Online*, *31*(10), 1-11. Retrieved August 8, 2008 from Academic Search Premier database.

Morgan, D. & Alwin, D. (1980). When less is more: School size and student social participation. *Social Psychology Quarterly, 43*(2), 241-252. Retrieved November 20, 2006 from Academic Search Premier and Master File database.

Morse, J., Barnett, M., Mayan, M., Olsen, K. & Spiers, J. (2002). Verification Strategies for establishing reliability and validity in qualitative research. *International journal of Qualitative Method*, *1*(2), 1-19. Retrieved August 23, 2008 from Academic Premier and Master File database.

Munro, M. & Elsom, D. (2000, January). Choosing science at 16: The influence of science teachers and career advisers on students' decisions about science subjects and science and technology careers. Monograph for *National Institute for Career Education and Counseling* (NICEC Briefing ED448334), 1-8. Retrieved October 26, 2006 from ERIC database.

Murphy, P. & Whitelegg, E. (2006, September). Girls and physics: Continuing barriers to 'belonging'. *Curriculum Journal, 17*(3), 281-305. Retrieved December 8, 2006 from Academic Search Premier and Master File database.

Nash, R. (2002, Sept). Numbers and narratives: Further reflections in the sociology of education. *British Journal of Sociology of Education, 23*(3), 397-412.

Nasir, N. & Saxe, G. (2003, June-July). Ethnic and academic identities: A cultural practice perspective on emerging tensions and their management in the lives of minority students. *Educational Researcher, 32*(5), 14-18. Retrieved March 17, 2007 from ERIC database.

National Assessment of Educational Progress (2005). *Nation's Report Card*. Downloaded September 12, 2008 from http://nationsreportcard.gov/tuda_science/t0101.asp

National Science Foundation (2007). Back to school: Five myths about girls and science. Press Release 07-108. Retrieved February 28, 2009 from http://www.nsf.gov/news/news_summ.jsp?cntn_id=109939

NEA Editors (1999, September). William Pollack on decoding boys. *NEA Today*, 18(1), 21.

Newmann, F. M. (1986). Priorities for the future: Toward a common agenda. *Social Education, 50*(4), 240–250. In *Using Positive Student Engagement to Increase Student Achievement*. Washington DC: Center for Comprehensive School Reform and Improvement 2007 Report, Office of Elementary and Secondary Education. Retrieved August 3, 2008 from ERIC database.

Oliver-Hoyo, M. & Allen, D. (2006). Attitudinal effects of a student-centered active learning environment. *Journal of Chemical Education, 82*(6), 944-949. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Olszewski-Kubilius, P. & Seon-Young, L. (2004, Spring). The role of participation in in-school and outside-of-school activities in the talent development of gifted students. *The Journal of Secondary Gifted Education, 15*(3), 107-123. Retrieved November 5, 2006 from ERIC database.

O'Neill, K. & Polman, J. (2004). Why educate "little scientists?" Examining the potential of practice-based scientific literacy. *Journal of Research in Science Teaching, 41*(3), 234-266. Retrieved August 8, 2008 from Academic Search Premier and Master File database.

O'Neill, T. & Barton, A. (2005, October). Uncovering student ownership in science learning: The making of a student created mini-documentary. *School Science & Mathematics, 105*(6), 292-301. Retrieved October 21, 2006 from ERIC database.

Ostro, H. (2006, October). Should athletes be required to maintain a specific academic level? *Coach & Athletic Director*, *76*(3), 16-17. Retrieved December 28, 2006 from Academic Search Premier and Master File database.

Painter, J., Tretter, T., Jones, G. & Kubasko, D. (2006, April). Pulling back the curtain: uncovering and changing students' perception of scientists. *School Science and Mathematics, 106*(4). Retrieved October 19 2006 from Academic Search Premier and Master File database.

Paris, S., Yambor, K. & Packard, B. (1998, January). Hands-on biology: a museum-school-university partnership for enhancing students' interest and learning in science. *The Elementary School Journal, 98,* 267-88. Retrieved December 31, 2006 from ERIC database.

Pedretti, E. (2006, January). Informal science education: Critical conversations and new directions. *Canadian Journal of Science, Mathematics, & Technology Education, 6*(1), 1-8. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Peshkin, A. (2000). The nature of interpretation in qualitative research. *Educational Researcher*, *29*(9), 5-9. In Gall, M., Gall, J. & Borg, W. (2007). *Educational research: An introduction* (8th ed.), 454. Boston, MA: Pearson.

Phelps, M., Peach, L. & Reddick, T. (1998, May). A study concerning curricular and extracurricular considerations in rural schools. Presentation at ICRSF '98: *Invitational Conference on Rural School Facilities*. Kansas City, MO. Abstract retrieved December 26, 2006 from the ERIC database.

Pinciotti, P. (1993, July/August). Creative drama and young children: The dramatic learning connection. *Arts Education Policy Review, 94*(6), 24-29. Retrieved February 8, 2008 from Academic Search Premier and Master File database.

Pinhey, T., Perez, M. & Workman, R. (2002, December). The fighting behavior of Asian-Pacific males in Guam: Do high school ECA matter? *Social Science Quarterly, 83*(4), 1086-1096. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Pipho, C. (1986, November). States support academic rigor. *Phi Delta Kappan, 68*(3), 189-190. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Posner, J. & Vandell, D. (1994, April). Low-income children's after-school care: Are there beneficial effects of after-school programs? *Child Development, 65*(2), 440-56. Retrieved December 26, 2006 from ERIC database.

Posner, J. & Vandell, D. (1999, May). After-school activities and the development of low-income urban children: A longitudinal study. *Developmental Psychology*, *35*(3), 868-79. Retrieved December 26, 2006 from ERIC database.

Powell, K. (2004). Developmental psychology of adolescent girls: Conflicts and identity issues. *Education, 125*(1), 77-87. Retrieved November 3, 2006 from ERIC database.

Quaiser-Pohl, C. & Lehmann, W. (2002, June). Girls' spatial abilities: Charting the contributions of experiences and attitudes in different academic groups. *British Journal of Educational Psychology, 72*(2), 245-261. Retrieved August 8, 2008 from Academic Search Premier and Master File database.

Regnier, M. & Planty, M. (2003). Volunteering trends among young adults. Presentation at AAPOR '03: *American Association for Public Opinion Research.* Nashville, TN. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Rehberg, R. & Schaefer, W. (1973, February). Participation in student activities as a variable in the education attainment and expectation process. Presentation at AERA '73: *American Educational Research Association*. New Orleans, LA. Abstract retrieved November 30, 2006 from the ERIC database.

Reid, J., Kamler, B., Simpson, A. & Maclean, R. (1996, January-March). Do you see what I see? Reading a different classroom scene. *International Journal of Qualitative Studies in Education, 9*(1), 87-108. Retrieved March 16, 2008 from ERIC database.

Reid, N. & Skryabina, E. (2002). Attitudes towards physics. *Research in Science & Technological Education, 20*(1), 67-81. Retrieved July 17, 2007 from Academic Search Premier and Master File database.

Reilly, D. (2000, Winter). The learner-centered high school: Prescription for adolescents' success. *Education, 121*(2), 219-229. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Reis, S., Colbert, R. & Hebert, T. (2005, Winter). Understanding resilience in diverse, talented students in an urban high school. *Roeper Review, 27*(2), 110-120. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Reis, S. & Diaz, E. (1999, March). Economically disadvantaged urban female students who achieve in schools. *Urban Review, 31*(1), 31-54. Retrieved December 29, 2006 from Academic Search Premier and Master File database.

Robertson, H. (2001, March). The teacher indentured servitude act. *Phi Delta Kappan, 82*(7), 559. Retrieved August 8, 2008 from Academic Search Premier and Master File database.

Rosenthal, R. & Rosnow, R. (1975). *The volunteer subject*. New York: Wiley. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 186-187. Boston, MA: Pearson.

Rounds, J. (2006). Doing identity work in museums. *Curator, 49*(2), 133-150. Retrieved October 29, 2006 from Academic Search Premier and Master File database.

Ryan, G. & Bernard, H. R. (2000). Data management and analysis methods. In Norman K. Denzen & Yvonne S. Lincoln (Eds.), *Handbook of qualitative research*, 769-802. Thousand Oaks: Sage.

Ryen, A. (2004). *Ethical issues.* In C. Seale, G. Gobo, J.F. Gubrium & D. Silverman (Eds.). *Qualitative research practice,* 230-247. Thousand Oaks, CA: Sage.

Sadker, M. & Sadker, D. (1993, March). Fair and square? *Instructor, 102*(7), 44-49. Retrieved November 4, 2006 from the ERIC database.

Salkind, N. (2005). *Statistics for people who think they hate statistics*. Thousand Oaks, London: Sage Publications.

Salomon, G., Perkins, D. N. & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, 20* (1), 2-9.

Scardamalia, M., Bereiter, C. & Lamon, M. (1994). The CSILE project: Trying to bring the classroom into World 3. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 201-228). Cambridge, MA: MIT Press.

Scherer, M. (2002, September). Do students care about learning? *Educational Leadership, 60*(1), 12-17. Retrieved March 5, 2008 from Academic Search Premier and Master File database.

Schneider, B. & Younger, A. (1996, September). Adolescent-parent attachment and adolescents' relations with their peers: A closer look. *Urban Review, 28*(1), 95-108. Retrieved February 24, 2007 from ERIC database.

Schneiderman, M. (1973, June). Hints on how to run a successful biology club. *AIBS Education Review, 3*(2), 8-9.

School, parent, and community online communications (2004, August). *Media & Methods, 41*(1), 12. Retrieved December 28, 2006 from ERIC database.

Scott, A. B. & Mallinckrodt, B. (2005). Parental emotional support, science self-efficacy, and choice of science major in undergraduate women. *Career Development Quarterly, 53*(3), 263-273. Retrieved October 27, 2006 from ERIC database.

Shank, G. (2006). *Qualitative research: a personal skills approach* (2nd ed). Upper Saddle River, NJ: Pearson Education, Inc.

Shann, M. (2001). Students' use of time outside of school: A case for after school programs for urban middle school youth. *Urban Review, 33*(4), 339-356. Retrieved December 26, 2006 from ERIC database.

Shannon, C. (2006, 3rd Quarter). Parents' messages about the role of extracurricular and unstructured leisure activities: Adolescent perceptions. *Journal of Leisure Research, 38*(3), 398-420. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Silliker, A. & Quirk, J. (1997, March). The effect of extracurricular activity participation on the academic performance of male and female high school students. *School Counselor*, *44*(4), 288-294. Retrieved November 20, 2006 from Academic Search Premier and Master File database.

Silver, D. (1994, February). Science fairs: Tired of the same old, same old? *Science Scope, 17*(5), 12-16. Retrieved December 28, 2006 from ERIC database.

Simpkins, S., Davis-Kean, P. & Eccles, J. (2006, January). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology, 42*(1), 70-83. Retrieved November 4, 2006 from ERIC database.

Simpkins, S., Ripke, M., Huston, A. & Eccles, J. (2005, Spring). Predicting participation and outcomes in out-of-school activities: Similarities and differences across social ecologies. *New Directions for Youth Development, 2005*(105), 51-69. Retrieved

December 30, 2006 from Academic Search Premier and Master File database.

Skinner, E.A. & Belmont, M.J. (1993, December). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85*(4), 571-581. Retrieved June 24, 2008 from OVID database.

Skinner, E. A., Wellborn, J. G. & Connell, J. P. (1990, March). What it takes to do well in school and whether I've got it: The role of perceived control in children's engagement and school achievement. *Journal of Educational Psychology, 82*, 22–32. Retrieved June 24, 2008 from OVID database.

Slisz, J. (1989). Establishing the goals of a science fair based on sound research studies. *ERIC Clearing House Resources in Education (RIE), SE050794*, 1-59. Retrieved November 7, 2006 from ERIC database.

Smaling, A. (2002, Summer). The argumentative quality of the qualitative research report. *Journal of Qualitative Methods, 1*(3), 1-15.

Sorge, C., Newsom, H. & Hagerty, J. (2000, August). Fun is not enough: Attitudes of Hispanic middle school students toward science and scientists. *Hispanic Journal of Behavioral Sciences, 22*(3), 332-45. Retrieved July 26, 2008 from ERIC database.

Spiers, J. A. (2002). The pink elephant paradox (or, avoiding the misattribution of data). *International Journal of Qualitative Methods, 1*(4). Article 4. Retrieved January 7, 2007 from http://www.ualberta.ca/~ijqm

Stake, J. & Granger, C. (1978). Same-sex and opposite-sex teacher model influences on science career commitment among high school students. *Journal of Educational Psychology, 70*(2), 180-6. Retrieved August 2, 2008 from the ERIC database.

Stake, J. & Mares, K. (2005, April). Evaluating the impact of science-enrichment programs on adolescents' science motivation and confidence: The splashdown effect. *Journal of Research in Science Teaching, 42*(4), 359-375. Retrieved August 8, 2008 from ERIC database.

Steffes, J. (2004, May/June). Creative powerful learning environments beyond the classroom. *Change, 36*(3), 46-50. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Stohr-Hunt, P. (1996, January). An analysis of frequency of hands-on experience and science achievement. *Journal of Research in Science Teaching, 33*(1), 101-09. Retrieved December 31, 2006 from ERIC database.

Strauss, A. & Corbin, J. (1998a). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.) Thousand Oaks, CA: Sage. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 469. Boston, MA: Pearson.

Strauss, A. & Corbin, J. (1998b). *Basics of qualitative research. Techniques and procedures for developing Grounded Theory (second edition).* Thousand Oaks, CA: Sage. In Shank, G. (2006). *Qualitative research: a personal skills approach* (2nd ed), 130. Upper Saddle River, NJ: Pearson Education, Inc.

Sumrall, W. & Schillinger, D. (2004, March). Non-traditional characteristics of a successful science fair project. *Science Scope, 27*(6), 20-24. Retrieved Abstract November 9, 2006 from ERIC database.

Sutherland, L. (2005, Fall). Black adolescent girls' use of literacy practices to negotiate boundaries of ascribed identity. *Journal of Literacy Research, 37*(3), 365-406. Retrieved March 17, 2008 from ERIC database.

Swanson, C. (2002, November). Spending time or investing time? Involvement in high school curricular and ECA as strategic action. *Rationality and Society, 14*(4), 431-471. Retrieved August 6, 2008 from Academic Search Premier and Master File database.

Tai, R., Qi Liu, C., Maltese, A. & Fan, X. (2006, May 26). Planning early for careers in science. *Science, 312*(5777), 1143-4. AAAS. Retrieved August 25, 2007 from www.sciencemag.org

Talbott, E. (1997). Reflecting on antisocial girls and the study of their development: Researchers' views. *Exceptionality, 7*(4), 267-72. Retrieved December 28, 2006 from ERIC database.

Tamir, P. (1990-1, Winter). Factors associated with the relationship between formal, informal, & non-formal science learning. *Journal of Environmental Education, 22*(2), 34-42. Retrieved November 5, 2006 from ERIC database.

Tashakkori, A. & Teddlie, C. (1998). *Mixed methodology. Combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage. In Creswell, J.W. (2003). *Research design. Qualitative, quantitative, and mixed methods approaches* (2nd ed), 220. Thousand Oaks, CA: Sage.

Tavani, C. & Losh, S. (2003). Motivation, self-confidence and expectations as predictors of the academic performance among our high school students. *Child Study Journal, 33*(3), 141-151. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Taylor, J. & Chiogioji, E. (1988, Spring). The Holland and Andre study on extracurricular activities: Imbalanced and incomplete. *Review of Educational Research, 58*(1), 99-105. Retrieved November 30, 2006 from ERIC database.

Tesch, R. (1990). *Qualitative research: Analysis types and software tools.* New York: Falmer. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 465-473. Boston, MA: Pearson. *theory and classroom practice* (pp. 201-228). Cambridge, MA: MIT Press.

Thomas W. & Swaine, D. (1928). *The child in America*. New York: Knopf. In Berg, B. (2004). *Qualitative research methods for the social sciences* (5th ed), 9. Upper Saddle River, NJ: Pearson Education, Inc.

"Twenty science attitudes" (1990, January). *Rational Enquirer, 3*(3). Retrieved 8-12-07 from http://www.ksu.edu/biology/pob/modern_attitudes.html

Underiner, T. (2000, Summer). Beyond recognition, beholden: Toward a pedagogy of privilege. *Signs: Journal of Women in Culture and Society, 25*(4), p1293-98. Retrieved March 17, 2008 from ERIC database.

Van Bockern, S., Wenger, L. & Ashworth, J. (2004, Fall). Pathways from discouragement to courage. *Reclaiming Children & Youth, 13*(3), 149-154. Retrieved September 10, 2008 from Academic Search Premier and Master File database.

Van Matre, J., Valentine, J. & Cooper, H. (2000, April). Effect of students' after-school activities on teachers' academic expectations. *Contemporary Educational Psychology, 25*(2), 167-183. Retrieved Abstract November 2, 2006 from Academic Search Premier and Master File database.

Van Petegem, K., Aelterman, A., Rosseel, Y. & Creemers, B. (2007, September). Student perception as moderator for student wellbeing. *Social Indicators Research, 83*(3), 447-463. Retrieved November 2, 2006 from Academic Search Premier and Master File database.

Voegel, P., Quashnock, K. & Heil, K. (2004, May). The student-to-student chemistry initiative: Training high school students to perform chemistry demonstration programs for elementary school students. *Journal of Chemical Education, 81*(5), 681-684. Retrieved December 2, 2006 from Academic Search Premier and Master File database.

Vygotsky, L. (1978). *Mind in society: The development of higher mental processes.* Cambridge, MA: Harvard University Press. In Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action,* 20-35. Cambridge, MA: Harvard University Press.

Wanlass, Y. (2000, May). Broadening the concept of learning and school competence. *Elementary School Journal, 100*(5, sp. ed.), 513-527. Retrieved November 30, 2006 from ERIC database.

Waterman, A. (1984). Identity formation: Discovery or creation? *Journal of Early Adolescence, 4,* 329-341. In Darling, N., Caldwell, L. & Smith, R. (2005, 1st Quarter). Participation in school-based ECA and adolescent adjustment. *Journal of Leisure Research, 37*(1), 51-76. Retrieved November 20, 2006 from Academic Search Premier and Master File database.

Watson, C. (2006, August). Unreliable narrators? ‘inconsistency’ (and some inconstancy) in interviews. *Qualitative Research, 6*(3), 367-384.

Watson, J. (2003). Examining perceptions of the science fair project: Content or process? *School Library Media Research, 6*(1), 1-13. Retrieved November 9, 2006 from ERIC database.

Watson, T. (2004, June 21). Wizards of tomorrow. *Canadian Business, 77*(13), 38-44. Retrieved December 4, 2006 from ERIC database.

Weiss, H., Little, P. & Bouffard, S. (2005, Spring). More than just being there: Balancing the participation equation. *New Directions for Youth Development, 2005*(105), 15-31. Retrieved August 3, 2008 from ERIC database.

Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action.* Cambridge, MA: Harvard University Press.

“What do you do for fun?” (2004, May 24). *Business Week, 3884,* 110. Retrieved November 4, 2006 from Academic Search Premier and Master File database.

Wilds, E. (1917). The supervision of extra-curricular activities. *The School Review, 25*(9), 659-673. Retrieved November 30, 2006 from Academic Search Premier and Master File database.

Wilson, J., Cordry, S. & Uline, C. (2004, March). Science fairs: Promoting positive attitudes toward science from student participation. *College Student Journal, 38*(1), 112-115. Retrieved December 2, 2006 from Academic Search Premier and Master File database.

Wiper, H. (1973). A club that works. *The American Biology Teacher,* 439-440.

Wolcott, H. (1994). *Transforming qualitative data: Description, analysis and interpretation.* Thousand Oaks, CA: Sage. In Gall, Meredith, Gall, Joyce P. & Borg, Walter (2007). *Educational research: An introduction* (8th ed.), 463-464.

Boston, MA: Pearson.

Womack, S. (1999). Seven scientific attitudes. In *Trends in Instruction*. Retrieved August 12, 2007 from http://education.atu.edu/people/swomack/InstTrnd/tsld023.htm

Wortham, S. (2008, September). The objectification of identity across events. *Linquistics & Education*, *19*(3), 294-311. Retrieved September 10, 2008 from Academic Search Premier and Master File database.

Xie, H., Mahoney, J. & Cairns, R. (1999, March). Through a looking glass or a hall of mirrors? Self-ratings and teacher-ratings of academic competence over development. *International Journal of Behavioral Development*, *23*(1), 163-183. Retrieved November 5, 2006 from Academic Search Premier and Master File database.

Yarworth, J. & Gauthier, W. (1976, April). The relationship of various aspects of student self- concept and selected personal variables to participation in various types of school activities. Presentation at AERA '76: *American Educational Research Association*. Retrieved November 30, 2006 from the ERIC database.

Yasar, S. & Baker, D. (2003). The impact of involvement in a science fair on seventh grade students. Presentation at NARST '03: *National Association for Research in Science Teaching*. Philadelphia, PA. Retrieved November 7, 2006 from the ERIC database.

Zierold, K., Garman, S. & Anderson, H.(2005, September). A comparison of school performance and behaviors among working and non-working high school students. *Family and Community Health*, *28*(3), 214-224. Retrieved November 13, 2006 from Academic Search Premier and Master File database.

Zoldosova, K. & Prokop, P. (2006, October). Education in the field influences children's ideas and interest toward science. *Journal of Science Education & Technology*, *15*(3/4), 304-313. Retrieved September 12, 2008 from Academic Search Premier and Master File database.

Zuzovsky, R., Chen, D. & Tamir, P. (1990). Science knowledge acquired within and outside the school. *Studies in Educational Evaluation*, *16*(3), 399-420. Retrieved November 2, 2006 from the ERIC database.

Appendices

Appendix A

Meet Suzy Science and the Whiz Kids

Suzy Science and the Whiz Kids is a chemistry club project that addresses some of the major areas of concern encountered in science today: little experimentation and/or poor teacher preparation in elementary science, the small number of women in science, and the even smaller number of individuals going into science teaching. As a result, our project has three goals. The first and primary goal is to enhance hands-on science in elementary classrooms by using equipment and chemicals from high school, enabling children to do more experiments, see more reactions, and witness scientific principles in action. Children are encouraged to actively participate by volunteering, observing, measuring, inferring, predicting, and describing relationships—the essence of scientific processes.

The second goal is to encourage more girls to enter the field of science. The major character in our project is a girl, and girls are encouraged to join the project. In addition, project members are requested to call on girls and boys equally while they perform scientific demonstrations. The third goal is to encourage all the high school students to consider the teaching profession as a possible career choice. Students don't participate in the project because they want to be teachers. Often they don't want to be teachers, and some adults have already discouraged them from becoming teachers. But being put in a teacher-like position lets the students draw new conclusions, which frequently favor considering teaching as a profession.

At our high school, we encourage students who have taken or are currently taking chemistry to join the chemistry club. This ensures that the "Whiz Kids" will have sufficient background in safety procedures, the handling of chemicals, and correct use of the equipment. Students who show a great interest in people and/or in science, and those who have a flair for drama and comedy are strongly urged to join the project.

For the project, we match up students with costumes that are bright, cheerful, and eye-catching (see Appendix A). The costumes not only draw attention from the elementary students, but they also allow the high school students to teach without being labeled "teachers." We cast the character Suzy Science with a girl who shows leadership potential-she will be a role model for the younger girls. Her catchy title associates a girl's name with science.

Students contribute some of the costumes but the majority are handmade by and belong to the sponsor. The high school students choose a science demonstration to perform, which we describe as a trick to the younger students to get their attention. We make sure that they understand, however, that the demonstrations are science, not tricks. Many books are available as sources of demonstrations. Our Whiz Kids are very active in after-school activities so they have voted to meet before school at 6:30 AM. We hold some general sessions on stage presence: how to enter a classroom, introduce each other, keep the action moving, get all the children involved, support each other, generate enthusiasm, be each other's applause meters, use good questioning techniques, keep in character, and smile at everyone. We discuss some positive discipline actions. Then the Whiz Kids separate into squads of four or five, and each squad meets separately to learn their demonstrations and practice working together.

The Whiz Kids are allowed three school days during the year to visit elementary schools. On these days, the students are given excused absences and allowed to make up missed class work. The student council or the elementary school's PTA provides the funds for the sponsor's substitute teacher and for the group's transportation between the elementary school and the high school. At the beginning of the school year, we set a date and reserve a bus for the Whiz Kids. We use a copy of the elementary school's schedule and a floor plan to schedule the squads into consecutive 15-minute time slots in adjacent classrooms (see Appendix A). Our schedule is designed to blend with the daily flow of the building and create as little disruption as possible. Each classroom will see up to four squads as time permits. Small groups allow greater interaction between the Whiz Kids and the elementary school children as well as more direct involvement of the children with equipment as they assist the Whiz Kids. Approximately 2 weeks before the presentation date, elementary teachers receive letters requesting them to indicate the times of their visits and to check for any discrepancies in the schedules. We pick up confirmations from the elementary teachers one week before the visit, and the Whiz Kids hang posters in the elementary school to advertise our group. Other details, such as a place to hang coats, carts to carry our equipment, handouts, and prizes, are taken care of at this time.

On the day of the visit, students don costumes and makeup and we make last-minute refinements with squad leaders as the group waits for the bus. Upon our arrival at the elementary school, we leave a finalized master schedule with the office and Whiz Kids greet the children. The first squad into a classroom passes out a handout that illustrates the scientific method with cartoons on the front and contains project suggestions on the back. The sponsor monitors the quads, making sure they are on schedule, in the right room, and with the necessary equipment, prizes, and handouts. The sponsor also helps with any emergencies that may come up. Extra demonstrations and various office supplies are kept on the carts. Student helpers are enlisted to work in the halls, washing glassware, running errands, and keeping up with squads. We have also taken our project to Girl Scout groups who want to work on science badges, to the Boy Scouts' Blue and Gold Banquet, and on stage of a nearby mall for American Education Week.

Appendix A (cont.)

Figure 1. Some Whiz Kids characters and their demonstrations.

Character Name	Typical Demonstration
Suzy Science	Lemonade to grape juice (chemical reaction)
Angie Angel	Vision and strobe lights
Betsy Bunny	Soda fountain (chemical reaction)
Betty Bluebird	Paper airplanes (forces on a plane)
Bobby Bandmaster	Soda straws as flutes
Bonnie Butterfly	Gyroscopes and angular momentum
Clara Clown	Slinky and the three types of waves
Corky the Clown	Circus car & Bernoulli's principle
Cowboy Clyde	Series and parallel circuit boards
Cowgirl Kelly	Finger pops and pop guns (air pressure)
Electrifying Elsie	Van de Graff electrostatic generator
Gary Galaxy	Chemical garden
Larry Lightningbolt	Light and reflection with a lumirod
Mary Munchkin	Sling psychrometer and humidity
Melody the Elf	Musical beakers
Officer Friendly	Bubbles, balloons, and air pressure
Polly Pilgrim	Center of gravity and balancing
Princess Pocahontas	Electrostatic induction dancers
Sailor Dan	Fleet review and surface tension
Sally Swimmer	Acid indicators - blowing into BTB solution
Sammy Soccer	Bernoulli's principle with a vacuum cleaner

Appendix A (cont.)

Typical Schedule for an Elementary School Visit

Time	Measurements	Electricity & Magnetism	Sound & Light	Toys & Sports	Forces & Fun	Air Pressure	Cool Chemistry
9:00 - 9:15	22(3)	23(3)	24(3)	25(5)	26(5)	27(5)	X
9:15 - 9:30	X	22(3)	23(3)	24(3)	25(5)	26(5)	27(5)
9:30 - 9:45	24(3)	25(5)	22(3)	15(4)	27(5)	23(3)	26(5)
9:45 - 10:00	23(3)	16(4)	26(5)	27(5)	15(4)	18(2)	24(3)
10:00 - 10:15	19(2)	10(6)	1(K)	3(1)	16(4)	15(4)	18(2)
10:15 - 10:30	20(2)	1(K)	3(1)	19(2)	18(2)	16(4)	15(4)
10:30 - 10:45	18(2)	3(1)	4(1)	17(4)	20(2)	19(2)	16(4)
10:45 - 11:00	3(1)	X	11(II)	4(1)	17(4)	20(2)	19(2)
11:00 - 11:15	4(1)	9(6)	8(6)	11(II)	1(K)	17(4)	20(2)
11:15 - 11:30	1(K)	11(II)	9(6)	8(6)	4(1)	25(5)	17(4)
11:30 - 11:45	Lunch Time - Take a Break!						
11:45 - 12:05	Still Breaking for Lunch!						
12:05 - 12:20	13(1)	14(1)	X	22(3)	3(1)	11(II)	4(1)
12:20 - 12:35	14(1)	1(K)	2(K)	13(1)	8(6)	9(6)	10(6)
12:35 - 12:50	1(K)	2(K)	13(1)	14(1)	10(6)	8(6)	9(6)
12:50 - 1:05	2(K)	13(1)	14(1)	1(K)	9(6)	19(6)	X

Numbers circled represent non-continuous presentations.

X are available for additional visits.

Lines between numbers indicate floor changes between presentations.

Numbers in parentheses indicate the classroom's grade level.

Appendix B

Letter sent to Former Club Members

College of Education
Research #227
One University Boulevard
St. Louis, Missouri 63121-4499
Telephone: 314-516-6226
E-mail: kralinal@umsl.edu

Dear Whiz Kid,

Because you are a former member of Suzy Science and the Whiz Kids and the club's activities, you are invited to participate in a research study about your experiences in this high school extracurricular science activity. This research is being done under the auspices of the Division of Teaching and Learning, College of Education at the University of Missouri-St. Louis, Protocol #070702K. Participation in Suzy Science and the Whiz Kids and the club's activities is being studied for its impact on the members' experiences in high school. Approximately 400 former members of the club will be invited to participate in this research.

If you agree to participate in this research, you are asked to respond to a survey either online at http://CTLSilhouette.wsu.edu/surveys/ZS67380 or on the enclosed hard copy regarding your participation and experiences in Suzy Science and the Whiz Kids. It is anticipated that this survey will take approximately thirty minutes, depending on the length of your involvement in the club and its activities. A return-addressed stamped envelope is enclosed with this letter for your use. By choosing to respond to the survey by return mail, online, or e-mail, you are consenting to participate and have your responses included in the study, albeit unidentified.

If you are willing and interested in participating in a focus group or in being interviewed to discuss these experiences, please indicate this on the enclosed form as well. These activities will take one to three hours. An audio-recording device will be used for these activities but you have the option to not be recorded. A confirmatory letter will be sent to schedule focus groups and interviews, based on your and other participants' availability and schedules, either on campus or in a private home, whichever is more comfortable, agreeable and convenient for the participants. Once again, by choosing to participate in the focus groups or interviews, you are consenting to participate and have your responses included in the study, once again, unidentified.

Participation in the study will allow your experiences in this extracurricular activity to be compiled and analyzed for the impact on students' experiences in high school. The results of this study will be used to complete the research for dissertation purposes and to share this body of knowledge pertaining to student participation in extracurricular science activities. There are no anticipated risks and discomforts that are associated with this research. While there are no costs associated with participating in this research, you will also not be paid for your participation in this research. Benefits include reflecting, discussing and sharing your memories and experiences in the activities that may recall and enhance the good times we shared.

No information about you, or provided by you during the research, will be disclosed to others without your written permission, except if necessary to protect your rights or welfare (for example, if you are injured and need emergency care or when the University of Missouri-St Louis Institutional Review Board monitors the research or consent process); or if required by law. When the results of the research are published or discussed in conferences, no information will be included that would reveal your identity. Only those photographs or images taken previously during the club's performances in which all individuals have given their consent will be used, albeit unidentified. These images will be used only for educational purposes, and your identity will be protected or disguised. Any information that is obtained in connection with this study, and that can be identified with you, will remain confidential and will be disclosed only with your permission or as required by law. Data from returned surveys will be recorded and stored on a separate external hard drive at a single location that is password protected to prevent access by unauthorized personnel. Hard copies will be stored in a personal locked cabinet for up to five years. Later, surveys will be shredded and the papers destroyed. Responses for online questionnaires will be downloaded to the same separate hard drive for processing and filing. Identifying information will be kept under lock and key and when results of the research are published or discussed at conferences, no identifying information will be included. Data will be used and shared in the dissertation publication. Prior to that point, any identifiers from your information will be removed, making it impossible to link you to the study.

It is your choice to be included in this study. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You also may refuse to take part or answer any questions you do not want to answer and still remain in the study. You may be withdrawn from this research if circumstances arise which warrant doing so. The Notice of Privacy Practices describes the procedures used by UM-SL to protect your information and a copy of the document will be made available to you upon your request. If you have any questions about your rights as a research subject, you may call the Chairperson of the Institutional Review Board at 314-516-5897.

Thank you for considering this request for your participation. Despite the years since your participation in the club, the memories you are willing to share will shed light on the impact of extracurricular science activities. Please feel free to contact me at 636-530-7162 if you have any questions or would like to discuss this research further. I look forward to working with you again!

Sincerely,

Linda M. Kralina
Senior Lecturer

Appendix B (cont.)

Sample Focus Group/Interview

College of Education
8001 Natural Bridge Road
St. Louis, Missouri 63121-4499
Telephone: 314-516-6226
E-mail: kralinal@umsl.edu

I am willing and interested in participating in additional opportunities to discuss my experiences as a member of the high school club, “Suzy Science and the Whiz Kids.” I understand these activities will take one to three hours. An audio-recording device will be used for these activities but I have the option to not be recorded. Please complete the information requested, check all the boxes that apply, and return in separate envelope to Linda Kralina, 16264 Windfall Ridge Drive, Chesterfield, MO 63005.

Name ____________________________________

Phone Number: _______________________

E-mail address: __________________________

Best way/time to contact me is by: ☐ e-mail ☐ phone and the best time is ______

☐ I am interested in participating in a focus group.
☐ I am interested in being interviewed to discuss these experiences by telephone.
☐ I am interested in being interviewed to discuss these experiences in person.

I prefer to meet/talk on:

☐ Sunday ☐ Monday ☐ Tuesday
☐ Wednesday ☐ Thursday ☐ Friday
☐ Saturday

I prefer to meet/talk:

☐ Morning (9:00 AM - 12:00 PM)
☐ Afternoon (1:00 - 4:00 PM)
☐ Evenings (6:00 - 9:00 PM)
☐ Other (please specify) ____

My preference for meeting/talking would be

☐ At my home
☐ At your home
☐ On campus at a UMSL office
☐ Other (please specify) ____

A confirmatory letter will be sent to you to schedule focus groups and interviews, based on your and other participants' availability and schedules, either on campus or in a private home, whichever is more comfortable, agreeable and convenient for the participants. Once again, by choosing to participate in the focus groups or interviews, you are consenting to participate and have your responses included in the study, once again, unidentified.

Appendix C

Codes for Study Participants - Survey

Gender : F = Female; M = Male

Race: C = Caucasian; NC = Non-Caucasian

School: A = Public; B = Private

Leadership: Q = Squad Leader;

SS = Suzy Science;

N = None

Survey #	Gender	Years in Club	School	Race	Leadership
1	M	1	A	C	N
2	M	1	A	C	N
3	F	1	A	C	N
4	F	2	B	C	SS
5	F	3	A	C	SS
6	F	2	B	C	Q
7	F	1	B	C	N
8	F	3	A	C	SS
9	F	3	A	C	Q
10	F	1	A	C	Q
11	F	2	A	C	N
12	F	1	A	C	N
13	F	3	A	C	Q
14	F	1	B	NC	N
15	F	2	A	C	N
16	F	1	A	C	N
17	F	1	B	C	N
18	F	1	A	NC	N
19	F	2	A	C	Q
20	M	2	A	C	N
21	F	2	A	C	SS
22	M	2	B	C	Q
23	F	3	A	C	Q
24	M	2	A	C	N
25	F	3	A	C	Q
26	F	2	A	C	Q
27	F	1	A	C	N
28	F	2	A	C	Q
29	M	1	A	C	N
30	F	2	A	C	SS
31	F	1	A	C	N
32	F	2	B	C	N
33	F	2	B	C	N
34	F	1	A	C	N
35	F	2	A	C	N
36	F	2	B	C	SS
37	F	2	B	C	Q
38	M	2	B	C	N
39	F	2	B	C	N
40	F	2	B	C	N
41	M	2	A	C	N
42	M	2	A	NC	Q
43	M	2	B	C	N
44	F	1	B	C	N
45	F	1	A	C	N

Appendix C (cont.)

Codes for Study Participants – Survey (cont.)

Survey #	Gender	Years in Club	School	Race	Leadership
46	F	2	B	C	N
47	M	1	A	C	N
48	M	2	A	C	N
49	M	2	A	C	Q
50	F	2	A	NC	Q
51	M	2	A	C	N
52	F	1	A	C	N
53	M	2	A	NC	N
54	F	2	A	C	Q
55	F	2	A	NC	Q
56	M	1	A	C	N
57	F	2	B	C	Q
58	F	2	B	C	N
59	F	2	B	C	Q
60	F	1	A	C	N
61	M	2	A	C	Q
62	M	1	A	C	N
63	F	1	A	C	N
64	M	2	A	C	Q
65	M	2	B	NC	Q
66	F	2	A	NC	N
67	F	2	B	C	N
68	M	1	A	C	N
69	F	1	A	C	N
70	F	2	A	C	N
71	M	1	B	NC	N
72	M	2	A	NC	Q
73	F	2	B	NC	N
74	M	1	B	C	N
75	M	1	A	C	N
76	F	1	A	NC	N
77	M	1	B	C	N
78	M	2	B	C	Q
79	F	1	B	C	N
80	M	2	A	C	N
81	F	2	A	NC	Q
82	F	2	A	C	SS
83	F	2	A	C	N
84	F	2	B	C	N
85	M	2	A	C	N
86	M	1	A	C	N
87	F	1	A	C	N
88	F	2	B	NC	N
89	F	2	A	C	Q
90	F	3	B	NC	N
91	M	2	A	C	N
92	F	1	A	C	N

Appendix C (cont.)

Codes for Study Participants - Interview

Gender : F = female; M = male

Race: C = Caucasian; NC = Non-Caucasian

School: A = Public; B = Private

Leadership: Q = Squad Leader;

SS = Suzy Science;

N = None

Interview #	Gender	Years in Club	School	Race	Leadership
1	F	2	A	C	SS
2	F	2	B	C	SS
3	F	3	A	C	SS
4	M	1	A	C	N
5	F	1	A	C	N
6	M	2	A	C	Q
7	F	1	A	C	N

8	M	3	B	C	Q
9	F	2	A	C	N
10	M	1	A	C	N
11	M	1	A	C	N
12	F	1	A	C	N
13	F	2	B	C	N
14	F	1	A	C	N
15	F	3	A	C	SS
16	F	3	B	NC	N
17	M	2	B	C	Q
18	F	3	A	C	SS

Appendix D

Survey Questionnaire Given to Former Club Members

Suzy Science & the Whiz Kids© Survey Questionnaire

Thanks for your willingness to participate in this study regarding the high school extracurricular science club, "Suzy Science and the Whiz Kids." Your input is important to this study and your responses are invaluable as to the program's impact and enhancement of extracurricular activities. Although these questions regard experiences and events encountered some time ago, your memories, perceptions, and best recollections about the events are all significant and the ones most important for this research.

The survey should take about 30 minutes, but there is no time limit. Please fill in your responses in the spaces provided. Please explain your answers, being specific as possible as to why you responded the way that you did. Once you have finished, click "Submit" at the end of the survey. Those who have indicated their interest in further discussions will be contacted by e-mail regarding dates and times.

General Information

1. Which high school did you attend and what year did you graduate?
2. What education/training have you had since high school? (include highest levels reached)
3. Briefly describe your current profession or vocation.
4. Describe any volunteer work in which you regularly participate (civic, community, church, service, medical, service, educational, coaching, etc.)

Appendix D (cont.)

5. Please indicate the degree to which you believe you possess each of the following qualities on a scale of 1 to 5, with 1 indicating a characteristic seldom evident in you and 5 indicating a characteristic consistently evident in you. To what degree do you consider yourself to be a person who demonstrates . . .

   A. Respect for views and opinions of others

   B. Open-mindedness, flexibility

   C. Belief in cause and effect

   D. Intellectual curiosity, inquisitiveness

   E. Imagination, creativity

   F. Objectivity

   G. Organization, efficiency

   H. Communication, cooperation with others

   I. Warmth, empathy, and humor

   J. Ethical behavior, integrity

Club Membership

6. How would you describe your attendance and involvement in our high school science club, including your character(s) and positions?
7. Suppose a student has just joined the club at the beginning of a school year, what was the typical training or preparation to be a member of “Suzy Science and the Whiz Kids” that this student could expect?
8. Approximately how much time did you spend per week on club activities at the highest point of your involvement?

Appendix D (cont.)

Club Activities (Please give specific examples whenever possible)

9. Relate some of your most memorable experiences as a member of Suzy Science and the Whiz Kids.
10. Think about your own demonstration(s), especially, in your first and last presentations. How would they compare? Explain any differences that occurred.
11. Think about the other members of your particular squad(s). Were there ever any changes made in your squad's presentations from one classroom to the next? If so, what were they? Try to be as specific as possible.

Evaluation of Your Experiences (Give specific examples whenever possible)

12. What did you like best about the club, Suzy Science and the Whiz Kids?
13. What made you want to be a member of Suzy Science and the Whiz Kids?
14. Using a scale of 1 to 5 where 1 means no interest/comments at all and 5 means definite interest or support, how would you describe your parents' attitude about your participation in the club? What did your parents think or say about your participation in the club?
15. What impact did wearing costumes have? (Would the club have had the same impact if presentations had been done without wearing costumes?)
16. On a scale of 1 - 5 where 1 is no cooperation at all and 5 means good communication and cooperation, how well did your squad work together? What helped or hindered your collaboration?
17. Did your participation in the club affect your attitude toward science? If so, in what way(s)?

Appendix D (cont.)

18. Did your participation in the club increase your knowledge of science? If so, in what way(s)?
19. On a scale of 1 to 5 where 1 means no satisfied at all and 5 means very satisfied, how well did your participation in the club meet your needs and expectations? What made you decide on this rating?
20. On a scale of 1 to 5 where 1 means no effect at all and 5 means significant effect, what impact did your participation in the club have on your overall high school experience? In what way(s)? To what extent?

Evaluation of the Program

21. Some people might say that the club's visits to the elementary schools were just a way for high school students to get out of classes for the day. How would you respond to them?
22. On a scale of 1 to 5 where 1 means no effect at all and 5 means significant impact, how successful do you believe the members of your squad were in engaging every child's attention in the classroom during your presentations? What makes you think this?
23. What specific evidences make you believe that the elementary school children learned any science from your presentations?
24. On a scale of 1 to 5 where 1 means no effect at all and 5 means significant effect, what impact did your participation in the club have on any areas of your professional and/or personal life? In what way(s)? To what extent?

Appendix D (cont.)

25. After you graduated from high school or left the club, did you ever make any references to your experiences in this club? Please explain your answer, being as specific as possible.
26. What other or additional activities in the club would have been helpful to further your interests or education?
27. Please include any other comments or reflections about Suzy Science and the Whiz Kids that you would like to share for the research.

Appendix E

Interview Questions Given to Former Club Members

Suzy Science & the Whiz Kids© Interview Questions

Each interview will include a codename and brief introductory, factual descriptors of the interview participant, and relevant characteristics.

1. What was the purpose of the club, Suzy Science and the Whiz Kids?
2. What was your favorite subject in high school?
3. During high school, what career options were you considering?
4. How well did the club prepare you to give the presentations to children?
5. What or who made you want to be a member of the club?
6. Describe some of your most memorable experiences as a member of Suzy Science and the Whiz Kids.
7. What do you remember about Suzy Science and the Whiz Kids' 'fan mail' and what was your response to it?
8. Describe the ways in which the members of your squad supported each other during presentations.
9. What actions did you take to engage children, especially very quiet ones, in your presentations?
10. What actions did you take to reduce or avoid disruptions during presentations?
11. Describe the quantity and quality of the children's reactions/behaviors to your squad's presentations.
12. What was the elementary classroom teachers' reactions/behaviors to your squad's presentations?

Appendix E (cont.)

13. "Kids say the darnedest things" is a famous quote by Art Linkletter. What were the most unusual things you heard kids say during or about your presentations?
14. Do you think your presentations were more or less interesting that the usual science lessons for the children? What makes you think that?
15. What impact do you think the club had on the subsequent science lessons in the elementary school classrooms?
16. What did you learn about yourself, because you were a member of the club?
17. Would Suzy Science and the Whiz Kids really have had the same impact on you if costumes and make-up had not been used?
18. Did you ever have any safety concerns while performing your demonstrations?
19. Did your experiences in Suzy Science and the Whiz Kids affect your achievement in high school classes, particularly science classes? Please explain your answer.
20. Did your experiences in Suzy Science and the Whiz Kids influence your choices for post-secondary training or career choices? Please explain your answer.
21. If you had it to do all over again, what would you do differently about your involvement in the club, Suzy Science and the Whiz Kids, during high school?
22. What benefits would you cite as reasons why high school students should be a member of an extracurricular science club like Suzy Science and the Whiz Kids?
23. Do you have any other comments or reflections about Suzy Science and the Whiz Kids that you would like to share with the researcher?

Appendix F

Coding Schema Templates: Behavioral Engagement

Category / Label	Values/ Sources	Explanation	Prototypical Example	Rules for Coding (when to use)
BE Behavioral Engagement - a measure of the student's involvement and participation with respect to inter-personal skills, adhering to norms, conduct and on-task behavior	A Attendance & Involvement	BE as participating through regular attendance, involvement,	"I attended all events." "Only missed when had sports conflict." "Not really involved."	Used for attendance at club meetings or events, NOT other ECA activities
	L Leadership	BE pertaining to demonstrating leadership skills, governance	"I was Squad Leader" "I was Suzy Science" "I showed others how to do their demos."	Used for leadership in the club, NOT leader-ship by others
	O Leadership by others	BE enhanced through the leadership of other members	"Older members showed me how to. ." The others told me how to give demo"	When leadership is acknowledged in other members of the club, NOT self
	P Persistence/ Longevity	BE by persistent membership, participating for more than 1 year, or all possible	"I belonged 3 years." "I joined as a senior; only in one year." "Ms. K left so I was only in it for 1 year."	Used for years in the club, NOT the amount of time spent in club times and functions
	R Routines & Procedures	BE as routines, procedures, or order followed by club members; characters, or demos presented	"Costumes held the children's interest." "I was a clown." "We got kids excited about our demo." "I did a bubble thing"	Used to describe typical procedures, NOT used when developed their own demos, or improved routines
	T Teacher	BE regarding interactions with teacher/sponsor	"Mrs. K showed me" "The teacher helped me pick a costume."	Used with teacher interactions, but NOT emotional
	W Working with others	BE as getting along with each other; working cooperatively	"We got along." "We worked well together."	Used to describe social interactions, NOT just friends; team spirit.

Appendix F (cont.)

Coding Schema Templates: Cognitive Engagement

Category / Label	Values/ Sources	Explanation	Prototypical Example	Rules for Coding (when to use)
CE Cognitive Engagement - a measure of the student's investment and commitment to the club with respect to persistence to goals, focusing on self-regulated learning and motivation	C Challenging tasks	CE as willingness to take on challenging tasks, to design own demos; flexible problem-solving	"We figured out our own demonstrations." "I had to figure out how to present to kids" "It isn't easy to get every child engaged."	Used to describe create/design/ improve demos, to figure out how to modify it, NOT by specific directions
	E Learning Experience	CE as a learning experience, skills learned because of participation; beyond classes	"A great learning experience for me." "Public speaking" "Stuff not covered in our classes."	Used for learning in club participation, NOT specific science content
	L Life goals and values	CE as working toward meaning-ful life goals & values; develop beneficial skills; intrinsic motives	"I was doing some-thing good for others." "It was rewarding to give something back to the community."	Used to describe actions past club design, based on own values, NOT just thinking what might be good/true
	M Mastery of skills and content	CE in working to master demos; competent; how to present demo; reflecting on how to improve demo	"I learned how to. . ." "My squad practiced to give presentation." "We met and chose demos and decided order to give them."	Used to describe demos & efforts to when preparing or performing their standard science demonstrations
	P Persistence/ Effort	CE as working above expectation, improving demo; more than 3 hours per week	"Spent 5 hours per week on club work." "I got better the more times I presented." "Worked a long time"	Used for time spent on club improvements in demos, NOT time for all ECA times
	R Reasons	CE in willful rationale for joining the club	"I joined because my sister did it." "I liked science."	Used for reasons to join club, NOT when they joined

Coding Schema Templates: Emotional Engagement

Category / Label	Values/ Sources	Explanation	Prototypical Example	Rules for Coding (when to use)
EE Emotional Engagement – a measure of the student's attitudes, feelings, values and interests, socially constructed and influenced by friends, parents, teachers, activities, and school environment.	A Activities of club	EE pertaining to feelings about the activities and its social interactions	"It was fun to do the demos for the kids." "I liked going to the Science Center"	Used for reactions to club activities, NOT children's responses
	B Belonging	EE pertaining to feeling like one 'belongs', valued member	"We were family." "Felt like I belonged." "I was rather shy, so this helped me."	Used for feelings about belonging or part of a group, NOT assigned
	C Children	EE pertaining to feelings while working with elementary age children, teaching	"I loved to see their faces light up." "Enjoyed teaching kids, seeing them get excited in science"	Used for teaching, children's reactions, NOT demos themselves
	E Emotion	EE of personal feelings, attitudes w/ no source; tone	"Everyone was kind." "Loved every minute! "Relaxed atmosphere"	Used for feelings, NOT if specific source is given
	F Friends	EE pertaining to the influences of peers and friends	"We were all friends" "Didn't want to join but friend made me."	Used for attitudes socially influenced by prior friends
	I Intere st	EE pertaining to interest in science	"Love that science" "Attitude improved"	Used for feelings interest in science
	N New friends, or	EE pertaining to feelings for meeting new or making friends	"I liked all the new friends I made." "Liked working with other students."	Used for new friendships, NOT those first called friends
	P Parents	EE of perceptions of parents	"I didn't tell my parents about it." "Weren't involved."	Used for parent responses, NOT for parent interest
	S School or institution	EE pertaining to social ties to the schools or related institutions	"I made up all the work I missed." "The ES teachers helped us."	Used for comment of host or home school, NOT their sponsor
	T Teacher	EE pertaining to influences of teacher/sponsor	"My teacher made me feel welcomed." "She made it fun."	Used for inter-actions w/ sponsor, NOT ES teachers.
	W Wearing costumes	EE pertaining to the perceptions of students about wearing costumes	"Loved my costume." "Costume was fun." "We laughed at how silly we looked."	Used for reaction to costumes, NOT the perceptions of positions allowed.

Appendix F (cont.)

Coding Schema Templates: New Social Positioning

Category/ Label	Values	Explanation	Prototypical Example	Rules for Coding (when to use)
NP New Positioning – altered social positions with respect to peers, parents, teachers, or situations	A Actions	NP describing behaviors, doing new things or doing things differently	"Worked with people that normally would not associate with." "Be ready to be out of my comfort zone."	Used to express how experience changed actions or perceptions NOT generated within person
	C Costumes	NP by wearing a costume to give person new identity, able to take risks, see & try new things	"Costumes gave us new identity as a scientist." "It wasn't me that made the mistake – it was Sammy Soccer."	Used to describe new feelings as science experts for children, NOT to frighten children or play dumb
	I Identity	NP as a different social position with different skills, talents, friends, and ways of acting, feeling	"I met people that I normally would not associate with." "I learned how to engage students meaningfully."	Used to describe a new position, new skills, friends, NOT just physical characteristics
	P Point of view	NP by seeing things from a different point of view, from other perspectives	"Science became cool" "Experiencing things through their eyes" "I used to think that all jocks were stupid."	Used to describe new ways of looking at things, NOT just looking at new things
	T Team work	NP by working collaboratively with people, not just with friends; collaborating for a common goal	"We worked together as a team to learn our presentations." "As a team, we decided order and type of presentations."	Used for working in cooperative team effort, NOT with just a group of friends

Appendix F (cont.)

Coding Schema Templates: New Trajectories of Identification

Category/ Label	Values/ Sources	Explanation	Prototypical Example	Rules for Coding (when to use)
NT (New Trajectories of Identification) - altered sense or vision of future identities possible based on experiences and internal changes in attitudes, perception, not placed there by others	A Applying	NT by applying for jobs or college, resume building	"This will look good on my resume."	Used to apply for position, NOT based on outcome.
	C Career aspirations	NT by applying experiences to possible future careers or eliminating possibilities	"This really helped me decide to go into teaching." "public speaking experience would help in any career"	Used to describe career choices, skills, preparatory experiences, NOT careers ascribed by others
	E Educational Opportunities	NT in considering educational choices, or future opportunities; new understandings or ways of learning	"I'm going to a science college." "I wanted to explore areas of science outside the classroom."	Used to explore educational plans, ways of learning, NOT based on dictates or choices ascribed by others
	F Future self-image	NT by envisioning changes in one's self-image, attitudes, or feelings; predicting impact of experiences	"I've always been shy and being in the club would help me." "I'm shaped by my experiences." "Helped me to enjoy science more."	Used as envisioning what a future action or attitude might resemble based on experiences and feelings, NOT those ascribed by others
	R Reflection	NT in retrospect as adults, on schooling; or on beliefs held in the present based on past experiences	"I tell my kids that science is fun." "It should be taught like this in schools." "I would not have tried some things otherwise"	Used in discussing current beliefs or attitudes attributed to experiences in the club, NOT opinions posed by others

Appendix G

Demonstrations Cited by Former Whiz Kids

Beach ball and vacuum cleaner
Bernoulli's principle and air pressure
Black lights
Bromothymol blue to detect CO_2 in breath
Blowing up balloons with O^2
Bottle rockets
Calcium in water
Center of gravity
Concave and convex lenses
Cutting a hole in paper to walk through
Deliquescence
Dropping chalk into a bottle
Dust explosions
Egg catcher
Electrostatics – glass rod with fur
Fiber optics
Forces
Gender and center of gravity
Gloopy
Gravity experiments
Green cube with yellow paint
Guinea pigs
Gyroscope
Hovercraft
Igniting steel wool with batteries
Jell-O gum drops
Kubic bubbles
Lasers
Legos challenge
Lemonade-grape juice chemical reaction
Light bulbs in series and parallel circuits
Lighting bulbs with an EM generator
Magnets
Marshmallows in a vacuum
Making measurements
Oobleck
Oscillator
Paper airplanes
Pipetting liquids
Popping popcorn without a lid
Prisms
Pulse glass
Rainbows with milk
Robot
Scientific method and shoving
Soda fountains
Soda straw oboes
Sound vibrations
Sound waves and tuning forks
Spinning bicycle wheel
Static dancers
Swinging a glass of water on a tray
Van de Graf generator
Water Experiments
Weighing oxygen in a balloon
Wimhurst generator

Appendix H

Mind Your P's and Q's

Welcome to Chemistry Club!

I am glad that you have decided to join Suzy Science and the Whiz Kids. The rules for this club are best summed up by Gramma' Gerty, who said, "Mind your P's and Q's."

DO BE:

Patient – they are just kids. There's no organized plot against you.

Punctual – we rely on you and the kids are ready for you.

Positive – look for the good in others. If they tug on your costume, take them by the hand and say, "Do you like my costume?" and SMILE.

Precise – speak clearly.

Projecting – take a breath before you start and project your voice to the last person in the class.

Participating actively – stay in character ALWAYS. DO your trick or help keep the spirits up.

Persuasive – you get more flies with honey than vinegar.

Pleasant – decide, in advance, that you WILL like EVERY child.

Prepared – know your speech and equipment needs and make sure they get packed.

Particular about safety – stress those pre-cautions in your talk.

Personable – kids like to touch and be touched (a friendly pat on the shoulder). Use lots of eye contact.

DON'T BE:

Quarrelsome – it never resolves anything and it dampens the spirit.

Quick-tempered – calm down until you can discuss the problem reasonably.

Quick to pass the buck – resolve to do better next time.

Quitting when it gets tough – we are counting on you.

Quiet – make your presence felt. Your mouth isn't the only way.