Assessing Self-Esteem and Views of Science in High School Students Participating in a Museum-Based Service Learning Program
A Master's Thesis

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ASSESSING SELF-ESTEEM AND VIEWS OF SCIENCE IN HIGH SCHOOL STUDENTS PARTICIPATING IN A MUSEUM-BASED SERVICE LEARNING PROGRAM

By

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INTRODUCTION

Interest in service learning has been growing since the mid 1980s as a means of encouraging a more engaged citizenry among our nation's students (Melchoir and Bailis, 2002). As a result, assessing service learning programs has been receiving increasing attention over the past decade in the hopes of documenting the potential for authentic learning experiences (Eyler and Giles, 1994, 2002). Previous studies on service learning have primarily focused on a narrow set of traditional cognitive outcomes, such as GPA, school grades, and critical thinking skills, with mixed results, but there is growing interest in measuring outcomes related to personal development, citizenship, leadership, interpersonal development (Kezar, 2002), and gender differences (Wang et al., 1987; Hecht and Fusco, 1995). Since most service learning projects take place in informal learning environments educators and researchers are attempting to quantify intended learning outcomes in order to validate their effectiveness and to see if these outcomes meet required school standards (Kezar, 2002). Previous studies have specifically investigated the outcomes of students in informal environments such as science centers, after school programs, and non-formal school settings (Diamond et al., 1987, Wang et al., 1999). The goal of this study is to synthesize themes and outcomes related to service learning, science museum research, and informal learning theory and to compare the results found in this current study with those found in previous studies. Specifically, this study assesses whether changes occurred in student self-esteem, in student views of science, and if there were any gender differences in each as a result of participation in a six-week service learning program called *Rising Stars* at the Oregon Museum of Science and Industry in the summer of 2003.

Service Learning

Service learning in U.S. schools has been on the rise during the past two decades. Several large-scale service learning initiatives on the national scale were initiated in the 1990s including the *National and Community Service Act of 1990*, the *Serve America Program*, and *Learning in Deed.* According to the 1998 *Service Learning Survey,* 68 percent of all public schools and 98 percent of all private schools engaged students in community service or service learning programs (Pritchard, 2002). Billig (2000) reported that in 1999, 83 percent of all public high schools organized some form of community service for their students. Between the years 1984 and 1997 there was a dramatic increase in the number of high school students involved in service learning, from 81,000 to 967,262, a 3,663 percent increase (Shumer and Cook 1999). With such high student participation in service learning projects, it is becoming increasingly important to accurately document the benefits and possible shortcomings that these projects have on U.S. students.

Service learning is defined as an educational approach that focuses on providing students with a community service experience that also incorporates an academic learning component (Furco, 2002). In 1993, the Alliance for Service Learning in Education Reform defined service learning as a method that provides students with opportunities to use newly acquired academic skills and knowledge in real-life situations in their own communities (Johnson and Notah, 1999). Service learning differs from traditional community service in the fact that students are to be given time to reflect on their experiences and apply their knowledge to a curriculum-related community need (Furco, 2002). The goals of many service learning programs include sense of community, encouraging student altruism, developing critical thinking and problem solving skills, improving career awareness, and reducing student involvement in risky behaviors (Pritchard 2002). In service learning projects, students provide a service or volunteer for an organization in a structured environment with an integrated curriculum (Furco, 2002). Researchers have determined many benefits to the inclusion of service learning projects. Longitudinal data collected from college undergraduates from 1994 to 1998 found that service learning had significant positive effects on academic performance, values, self-efficacy, and leadership. Additional findings of the study found the inclusion of reflection time is an integral factor in all service learning programs, and that in successful service learning situations the student will acquire new skills that lead to self-reflection and self-discovery and can lead to increased engagement in the classroom experience (Astin et al., 2000). Researchers have defined service learning as "A form of experiential education where learning occurs through a cycle of action as students work with others through a process of applying what they are learning to community problems and, at the same time, reflecting upon their experience as they seek to achieve real objectives for the community and deeper understanding and skills for themselves" (Eyler and Giles 1999).

Although there has been an increase in service learning research there is still much to be learned. Eyler (2000) calls for researchers to rely less on student self-reporting and to "refine the definition of appropriate intellectual outcomes and design measurements that are convincing." These new types of measures will allow students to demonstrate that they have attained greater knowledge and problem solving skills and the ability to apply this new knowledge. In a review of service learning research Billig (2000) noted that few studies used control groups, tested hypothesis, tracked changes over time, or cited theoretical foundations on which the programs were based. These observations cite the need for improved research design and methodology in the study of service learning.

With the increase of U.S. schools adopting service learning projects into curriculum, more research will benefit school administrators and educators who are investigating the possibility of incorporating a service learning project into their curriculum. More relevant research into service learning would also be of interest to community organizations hoping to design service learning programs or improve upon existing service projects. As our schools evolve towards a more hands-on approach to learning, an increase in partnerships with community organizations that provide service learning opportunities in informal learning environments is expected. More focused research on how today's students benefit from service learning will help to add value and credibility to these experiences, and they will receive the greatest rewards through thoughtful and well-designed service learning projects.

Service Learning and Self-Esteem

To date there have been relatively few research studies that have looked at how service learning programs affect student self-esteem. In a review of service learning literature Johnson and Notah (1999) cited only two published studies from the 1980s and 1990s that found correlations between service learning and self-esteem. A 1999 study that investigated the effectiveness of a service learning program in terms of enhancement of student self-esteem serves as one of the models for this current study, in part due to the use of the Coopersmith Self-Esteem Instrument. In the study, 187 elementary and secondary students participated in the CHALLENGE service learning program employed in the Delano school district in California. The elementary students participated in a greenhouse construction project while the secondary students either participated in a tutoring program or in an improvement project at the Delano Historical Museum. The research questions focused on looking for significant differences in service learning groups and non-service learning groups, gender differences in self-esteem enhancement, and ways to improve similar service learning programs in the future. The results of this study showed a significant increase in student self-esteem (a=.05) for only the students that participated in the tutoring program. No significant differences were found between genders, however, self-esteem post scores were slightly higher in all three groups of students that participated in service learning programs (Wang et al., 1999). Johnson and Notah (1999) conducted a pilot study looking at the effects that service learning had on 156 eighth grade students and found slight increases in self-esteem using the Coopersmith instrument. On the contrary to the SEI scores, student interviews and journal entries demonstrated that students perceived increases in self-esteem and all found their service experience worthwhile.

A longitudinal study that took place in San Francisco's Exploratorium science museum investigated the ability of science museums to affect students' social development, attitudes towards science, and their interest in science, teaching, and museums. The "Explainer" program was initiated in 1969 when the Exploratorium opened and is very similar to the Rising Stars program with the students' role to explain science exhibits and concepts to museum visitors. In the study 116 students were surveyed and 32 interviewed. A significant number of students who were interested in science before participating in the program responded that their Explainer experience positively affected the number of science classes they took, or planned to take, in school or college. Females also scored significantly higher than males the program's positive impact on their communication skills and self-esteem. The conclusion of the study stated that the Explainer program influenced students' interest in learning science and increased their feelings of self-esteem and self-confidence in the workplace. These results indicated that programs such as these could play a "profound role in stimulating teenagers' social development, communication abilities and interest in science" (Diamond, et al., 1987).

Gender Differences and Service Learning

Research has shown that the different expectations boys and girls have towards service learning are an important factor behind gender differences associated with service learning (Hecht and Fusco, 1995). Studies have also suggested that females are more likely to participate in a broader range of service learning programs than males (Chesler and Scalera, 2000). Some have speculated this is due to females preparing for service-oriented careers and being more open to non-traditional educational programs. Some research suggests that girls' attitudes about social responsibility improve after participating in service learning (Hecht and Fusco, 1995). In a study that investigated gender differences among middle school students' motivations and expectations for service learning found that girls expected more from service learning in personal growth areas such as learning to care for others, better understanding of people, and improving their community than boys. Girls were more likely to report that after service learning they made new friends and became more prepared for the real world (Hecht and Fusco, 1995). Girls have scored significantly higher than boys in their desire to work with people when volunteering in a science museum (Diamond et al., 1987). Although studies have demonstrated that there are differences between genders in aspects of service learning, this is still an area of research that has many unanswered questions. According to Shirella, et al.

(1999) “The relationships of the [service learning attitude] scales to gender, although interesting, do pose questions. There is currently not enough research in this area to understand why males and females score differently or what the differences mean for actual participation rates in community service.” The implications of these gender differences could prove to be important for planning service learning projects or other service interventions.

Gender Differences in the Sciences

It has been well documented that females are underrepresented in scientific and technological courses and careers (Kahle and Meece, 1994; Roychoudhury et al., 1995). Research on gender issues in the sciences points to the fact that there exists a significant deficiency of women in science careers. For example, only sixteen percent of all employed scientists and engineers are women, while women earn only thirty percent of all bachelors’ degrees in natural science and engineering. Even more telling is that only twenty-one percent of women earn Ph.D.s in science, which corresponds to the low numbers of women in elite science careers. The literature review provided findings on why women are underrepresented in the sciences. Research has found that the decline in women’s attitudes and interest in science starts around age ten and continues through the high school years. It is a common misconception that males have superior mathematical and spatial cognitive abilities, however research has found that not to be the case. In fact, factors that seem to be more important include home life, socioeconomic factors, and social norms.

Socially, there are perceived to be classes that are male-oriented (physics, chemistry, engineering, etc.) and women-oriented (biology, nursing, liberal arts, etc.). In general, the field of science as a whole is perceived to be a masculine endeavor. Research has also shown that classroom interactions, and the ways in which many science classes are structured, favor boys (Kahle and Meece, 1994).

The Second IEA Science Study found that gender differences in the sciences favor boys in biology, physics, and chemistry starting in grade 5 and continuing through grade 12. Dweck (1986) found that, compared to boys, girls have been found to have lower self-confidence in their academic abilities and have lower achievement expectations in the traditionally “male domains” of science and mathematics (Kahle and Meece, 1994). Gender related differences in self-esteem could influence the beliefs of girls about their ability to do well in science and their willingness to take advantage of educational opportunities (Von Secker, 2004). One of the questions raised in this study is whether gender differences related to science would be observed in an out of school context and if these differences exist in the domain of service learning experiences.

Learning in Informal Environments

In the early 1990s research in the field of cognitive learning in science museums was a field still in its infancy (Feher, 1990). Since then, a considerable amount of research has been done in science museums, however a theoretical perspective of learning that takes place in such a situation has not been fully developed, and the effectiveness of such learning has been debated in many studies (Anderson, et al., 2003). Hofstein and Rosenfeld (1996) list three purposes of researching informal science learning environments. The first is directed to people who work in informal learning environments, which include science museums, zoos, outdoor settings, and after school programs. More thorough research pertaining to informal learning environments will provide staff with tools to better design and evaluate service learning programs for students. The second reason is to gain a theoretical understanding of how and under what conditions students learn science in informal learning environments. Finally, learning how to adapt informal science learning methods in formal school settings is of interest to individuals who work in traditional school settings.

The great majority of service learning projects take place in informal learning environments and according to Crane, Nicholson, and Chen (1994), "Informal learning refers to activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized by voluntary as opposed to mandatory participation as part of a credited school experience. Informal learning experiences may be structured to meet a stated set of objectives and may influence attitudes, convey information, and/or change behavior." Human constructivism is a learning theory that is often linked to informal environments and has the precept than an "individual's present conceptions are products of diverse personal experiences, observations of objects and events, culture, language, and teachers' explanations" (Anderson, et al., 2003). The constructivist model poses that learner's construct knowledge as they acquire new knowledge, constantly reorganizing facts to create both understanding and an ability to learn as they interact with the outside world (Hein, 1995). Constructivist theory is rooted in the writings of L. S. Vygotsky who listed constructs such as collaboration, participation, apprenticeship, community, and practice as key elements for understanding learning (Rodriguez, 1998). Sociocultural theory is also relevant to the learning that occurs in informal environments as it emphasizes the process of learning where meaning emerges from the interplay between individuals acting in social contexts and the mediators they interact with such as tools, communication, signs, and symbols. As a result, these mediators shape individuals and questions arise concerning how these mediators influence thinking (Schauble et al., 1997).

Osgood et al. (1975) used a standard semantic differential questionnaire and found that students perceive "science" and "school science" differently, specifically student attitudes towards school science were found to be less positive than their attitudes towards science in general. This suggests that out of school science experiences can play a role in enhancing students' attitudes about science by providing more student-centered and inquiry-based activities than typically associated with the presentation of science found in many of today's schools (Hofstein and Rosenfeld, 1996).

Research has shown that students typically don't develop an adequate understanding of scientific literacy and nature of science (NOS) through their participation in school science and the same has been seen in out of school science contexts (Bell et al., 2003). Science apprenticeships are often thought to provide students with the opportunity to receive implicit and explicit messages about NOS and scientific literacy. However, even after student participation in an extensive 8-week science apprenticeship, none of the 10 students participating in the study were found to have "adequate understandings of the nature of science," even after working closely with professional scientists (Bell et al., 2003). Hofstein and Rosenfeld (1996) suggested that teachers use a variety of formal and informal instructional strategies and learning materials to increase the effectiveness of their teaching. "Out of school learning is self-motivated, voluntary, and guided by learners' needs and interests, so certain aspects of learning are critical to investigate, e.g., the role of motivation, choice and control, interest, and expectations in the learning process." Longitudinal research designs that recognize that learning is a cumulative process have been recommended. Examples include concept mapping, personal meaning mapping, and social learning network analysis (Rennie et al., 2003).

Science Museums as Learning Environments

The rise of science museums in the 1960s and 1970s began a new paradigm for museum visitation—one where visitors were now able to interact with hands-on exhibits instead of being a passive observer. Science museums and other informal learning environments also have more of an emphasis on wider goals than normal "school learning" such as enculturation, development and attitude, and socialization (Schauble et al., 1997). With the rise of this new type of learning environment came the research that attempted to quantify the learning that was occurring in visitors, and this has proven to be more difficult than expected. The researcher's prototype for learning is still "school learning" and museum learning often does not fit into this prototype (Schauble et al., 1997). A distinction has been made between the learning that occurs in informal learning environments and the learning that occurs in schools, however Dierking (1991) argues that "learning is learning" and setting is important but is not necessarily the dominant factor. Anderson et al. (2003) states that researchers need to recognize that the learning that takes place in informal environments such as science museums is "multifaceted and unbounded by time, institution, or social context."

Researchers often look at three contexts when considering museum environments. The personal context has to do with a person's motivations and expectations—this is influenced by a person's prior knowledge, interests, and beliefs. The sociocultural context takes group interactions within the museum environment into consideration. Finally, the physical context deals with the design of exhibits, the use of orientation and advance organizers, and the reinforcing events and experiences outside of the museum (Falk, et al., 2000). When people enter a museum environment they are usually self-motivated and have choice and control over what they choose to learn.

Some researchers see the multisensory and hands-on nature of museum exhibits as an important component of learning (Anderson and Lucas, 1997), while other researchers have proclaimed the entertainment focus of museum exhibits presents science as unproblematic and value-free (Champagne, 1975). Rennie and Williams (2002) argue that researchers should not look for random bits of information that visitors to science museums learn, but instead they should measure whether their science-related experience has helped them to ultimately think differently about science. This research approach was chosen for this study.

Rennie and Williams (2002) conducted a study at an Australian science center that investigated 1) the understanding about science of center staff and their perceptions of the image of science portrayed by the center, 2) the ideas about science held by a sample of visitors to the center, 3) the impact of their visit on visitors' ideas about science, and 4) the perceptions of staff and visitors about the nature of science portrayed by the exhibits. Data were collected through interviews of staff and museum visitors and through a survey that measured visitors' perceptions, ideas, and opinions about science. The results of the data suggest that the science center portrays a "positive, but uncritical, view of science as definite, unproblematic, and all knowing." This corresponded to previous research that has shown that science museums do not offer a realistic view of science. However, the data also showed that visitors to the museum had a positive overall experience with science.

Theoretical Perspective

In an effort to provide the field of service learning with theoretical underpinnings, Giles and Eyler (1994) traced the roots of service learning to John Dewey's writings on educational and social philosophy that applies to learning from experience, reflection, and citizenship. Although Dewey's writings date back over seventy years, his ideas about how learning takes place, what learning is, and the relation of learning to action directly relate to recent service learning theory. In Dewey's writings he asked, "How is it that experiences are educative?" Various definitions of service learning have stated that an educational component must be worked into a structured experience for the student. Dewey proposed the Principle of Continuity and the Principle of Interaction, both of which make up his philosophy of experience. The Principle of Continuity states that all experiences occur along a continuum where these experiences build upon each other until there is development or growth in the learner. In the Principle of Interaction learning occurs when the subjective experience of the learner directly interacts with the objective experience itself (Giles and Eyler, 1994). The Rising Stars program curriculum works along a continuum starting with students learning the basics of presentation skills, gaining skills in the museum environment, and finally applying these new skills to work in museum science laboratories and to develop and present their own science demonstrations.

Time for reflection is also a hallmark of a service learning project. Dewey wrote extensively about how thinking and action are inextricably linked and coined the term “reflective thinking.” Dewey saw connections between reflective thinking and scientific inquiry, which includes observation time to process data and ideas (Giles and Eyler, 1994). When determining what makes a project “truly educative” he listed the following four criteria:

1) The project must generate interest
2) The project must be worthwhile intrinsically
3) The project must present problems that awaken new curiosity and create a demand for information
4) The project must cover a considerable time span and be capable of fostering development over time

Overall, the theoretical approach to this study will help to determine if the Rising Stars program is successfully incorporating John Dewey’s theories on educational experiences, reflective thinking, and project-based learning. Looking at how students take the concrete and abstract knowledge they gain in Rising Stars classroom sessions and apply it in a real world situation will be important to see if the Principles of Continuity and Interaction are being met.

PURPOSE STATEMENT AND HYPOTHESIS

The purpose of this two-phase, sequential mixed methods study was to assess whether the effects of a six-week, science-based, service-learning program produced changes in self-esteem and in views of science for high school students. A secondary goal of this research was to assess whether gender differences in these areas were present and affected by the service learning experience. The outcomes were measured with a mixed methods approach using both quantitative and qualitative tools. Quantitative data was measured using the Coopersmith (1967) self-esteem instrument, and the "Science Museum Survey" developed by Rennie and Williams (2002). Qualitative data was gathered during a post program focus group interview with eight randomly selected students who participated in the Rising Stars program. The hypothesis of this study is that students participating in the Rising Stars program will make significant gains in self-esteem and their views of science will be changed as a result of their museum-based service learning experience.

The goal of this research is to add to the body of knowledge on the effectiveness of service learning programs on students as well as investigating the role that science museums play in student views of science.

METHODOLOGY

The Rising Stars Program

Rising Stars is an on-going, community service, summer program that seeks to provide area high school students with relevant and engaging educational opportunities. There are two six-week sessions offered during the summer and students are encouraged to attain 90 hours of volunteer service in that time. The goals of the Rising Stars service learning program are for students to increase their understanding of scientific inquiry and demonstrate knowledge and attitudinal gains in the areas of science, job readiness, and presentation skills. The Rising Stars program was initiated in 1999 and is administered through the museum's volunteer services department. The mission of the program is to prepare students for today's workforce, meet state school requirements, and encourage community service. It also inspires students to actively discover their world through scientific inquiry by engaging in a combination of educational sessions and volunteer work experience. The Oregon Museum of Science and Industry's (OMSI's) unique position as a scientific and cultural resource center in the education/tourism market allows OMSI staff to combine on-the-job training and science education in the museum environment.

Students receive the bulk of their training during weekly daylong classes that focus on a variety of topics, including multiple areas of scientific inquiry, effective communication and customer service, respectful interaction with people with disabilities, cultural diversity, group interaction, and the value of community service. These classes help to expand students' understanding of the complexity of today's workplace, as well as broaden their view on how to communicate with people of various backgrounds and cultures. Classes also focus on "putting the WOW" in science through science education and hands-on activities. Students learn how to make an effective and interesting science presentation by practicing "pocket demonstrations" in the classroom before taking them onto the OMSI floor for visitors. Through these demonstrations, students have the opportunity to increase their self-confidence and to practice their public speaking and presentation skills. Here they gain experience and confidence as they implement the skills they have learned in class in a variety of different work scenarios. These classes make up one-third of the students' total time in the program. Students spend, on the average, two additional days per week working at their volunteer job assignments within the museum. During the 2003 *Rising Stars* program, student work areas included the museum's chemistry lab, physics lab, technology hall (with computer lab), early childhood education area, featured exhibit *Moneyville*, life science lab, paleontology lab, watershed lab, submarine, and visitor services department. The museum's education staff teaches students existing demonstrations and activities that relate to the work area. In turn, students present these demonstrations to museum visitors.

Students interact with OMSI staff and adult volunteers throughout the program, allowing them key opportunities to communicate with individuals with vast experience and expertise and to model their professional behavior and work ethics. These adults advise the students on appropriate behavior in a professional environment, listen to their ideas, offer constructive feedback and praise, and encourage them to continue with their education and community service. In turn, it is hoped that the students clearly understand the value they add to the museum, its staff, and visitors. Over the course of three years the program administrator has observed students' sense of responsibility and accountability rise along with their self-confidence and skill set.

The *Rising Stars* program is open to all high school aged students and attracts students from Portland, Oregon, metropolitan area public and private schools, however program participants also come from surrounding cities and school districts. Students come from varying socio-economic and ethnic backgrounds, and historically the ratio of boys to girls has been close to 1:1. Fifty-five students participated in the *2003 Rising Stars* program and, of those 55 students, 53% were from identified minority groups, 22% considered English as their second language, 45% were girls (n=25), 29% received financial assistance, and over 30 area high schools were represented.

The Study Site

The Oregon Museum of Science and Industry (OMSI) is non-profit, independent, scientific, educational, and cultural resource center dedicated to improving the public's understanding of science and technology. John C. Stevens, a Portland civil engineer, founded the museum in 1944. OMSI has the reputation of being one of the nation's top science museums and reaches over one million people annually through museum visitation, offsite camps and classes, and outreach programs. The museum's mission statement reads as follows:

The Oregon Museum of Science and Industry is a scientific, educational, and cultural resource center dedicated to improving the public's understanding of science and technology. OMSI makes science exciting and relevant through exhibits, programs, and experiences that are presented in an entertaining and participatory fashion.

Research Design

Data for this study was collected using a two-phase sequential exploratory strategy to investigate the phenomenon of the Rising Stars service learning program. In this mixed methods research study both quantitative and qualitative data were collected in the hopes of gaining a richer and more complex understanding of students' experiences in the Rising Stars program. Quantitative data was obtained from forty of fifty-five students participating in the program through two pre and post surveys. The fifteen students not accounted for were not present for either the pre or post survey. Qualitative data through a focus group interview after the program ended was obtained from eight randomly selected individuals in order to explore students' feelings about participating in the program in more depth. The administration of both surveys and the focus group interview were conducted in a classroom setting off the main museum floor. The independent variables in the study were the daily working environment of OMSI and the weekly classroom activities. The surveys and focus group investigated if the OMSI program affects change in student self-esteem and in their views of science.

QUAN → QUAL

quan data collection → *qual data collection* → *qual data analysis* → *quan data analysis* → *Interpretation of entire analysis*

Quantitative Methods

The first phase of Rising Stars data collection was through two quantitative pre surveys administered to all of the students at the program orientation. The Coopersmith Self-Esteem Inventory was used to measure student self-esteem, and the "Science Museum Survey" was used to measure student views of science. A one-group pretest-posttest design was used in this study, which can be diagramed as follows:

O1   X   O2

In this study design (O1) is the pretest, (O2) is the posttest, and X represents the exposure of the group to an experimental variable, in this case the *Rising Stars* program experience (Campbell and Stanley, 1963).

Coopersmith Self-Esteem Inventory

The Self-Esteem Inventory (SEI) developed by Stanley Coopersmith (1967) is designed to measure evaluative attitudes toward the self in social, academic, family, and personal areas of experience (Coopersmith, 2002). The School Form of the Coopersmith (SEI) was used for this study, which is typically used with students aged eight through fifteen and consists of 58 items. The SEI yields a total score (out of 100) and separate scores for four subscales: General Self, Social Self-Peers, Home-Parents, and School-Academic. The General Self subscale comprises 52 points, and the Social-Self-Peers, Home-Parents, and School-Academic subscales are each 16 points apiece. The format of the survey provides students with statements relating to self-esteem and the option to choose either "like me" or "unlike me." An example of one of the 58 statements reads, "I find it very hard to talk in front of the class."

Coopersmith cited four major contributors to self-esteem: 1) the value the child sees others having toward him or her, 2) the child's success experiences, 3) the child's definition of success or failure, and 4) the style used by the child in facing negative feedback from others. Coopersmith also likened self-esteem as a set of attitudes and beliefs that a person brings with them when facing the world (Coopersmith 1967). Furthermore, a student's self-esteem is directly linked to school academic performance according to previous research (Bledsoe, 1964; Bodwin 1962). This instrument was chosen for this study because it has been widely tested for its validity, reliability, sex differences, and for program evaluation (Coopersmith, 2002). The SEI has also been used in several studies that investigated how service learning experiences have affected student self-esteem (Perry, 1998; Johnson and Notah, 1999; Wang, et al., 1999).

Science Center Survey

The Science Center Survey developed by Rennie and Williams (2002) was designed to measure perceptions, ideas, and opinions about science of visitors to science museums. The survey is in a seven-point Likert scale format with two oppositely worded statements between the numbers. Therefore, respondents choose one of the seven points between the statements that they most agree with. An example of the survey's format and types of statements is as follows:

Only scientists need knowledge about science	1	2	3	4	5	6	7	Everyone needs knowledge about science

Questions were grouped into four main categories: *Science, Scientific Research and the Community, Science and Me*, and *Science at the Center.* According to Rennie and Williams the goal of the survey is to measure the cognitive and affective ideas that relate to science that would be relevant to a visit to a science center. The survey was purposely written with general statements not relating to specific exhibits to prevent cueing visitors in advance and in case visitors did not interact with specific exhibits. The general format in which this survey was written makes it appropriate for use in any science center or museum, which is one of the reasons it was chosen for this study. The survey was reviewed by a group of university scientists, sixteen science teachers at Curtain University, and tested with 42 randomly selected visitors to a science center in Western Australia**.** The survey was used in the original study to determine if museum visitors' views of science were changed after one visit to a science museum. Rennie and Williams sought to determine if people understand more or less about science from a visit to a science museum and if science museums are communicating the types of images of science that science educators might hope for.

Qualitative Methods

A focus group interview was conducted in January of 2004 with a group of eight randomly selected Rising Stars participants. Since reflection is one of the hallmarks of service learning, the researcher scheduled the focus group four months after the completion of the Rising Stars program. This allowed students to absorb the service learning experience and for the researcher to inquire whether their informal science experience had had any effect on their views of school science. The focus group was conducted in the same classroom within OMSI where students received their weekly training sessions and the interview was approximately 45 minutes in length. The researcher asked students the questions and recorded the interview.

RESULTS

Self-Esteem Survey Results

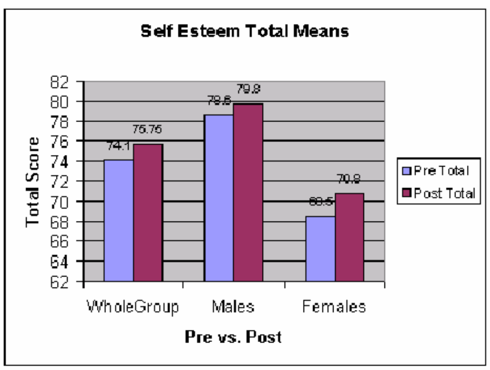
The quantitative data from the surveys was statistically measured for significance at the $p < .05$ level with SPSS software. The Coopersmith self-esteem survey was analyzed using paired samples t-tests when comparing the whole group and male and female group data. Independent sample t-tests were used when directly comparing male and female data to each other. Individual student pre and posttest scores were compared to look for significant changes in student self-esteem and in student views of science before and after completing the Rising Stars program.

Out of the forty students, twenty showed increases on the post self-esteem surveys, seven had identical pre and posttest scores, and thirteen showed declines on their posttest self-esteem scores. There were no statistically significant results from the Coopersmith self-esteem tests within the whole group and also when separated by gender. The mean pretest score for the whole group was 74.13 and the post score was 75.75. When separated by gender the males scored 78.64 on the pretest and 79.82 on the posttest. Females mean pretest score was 68.61 and posttest score was 70.78. Although means differed by nearly ten points between males and females on pretest and posttest scores, statistical significance was not found.

Table 1.
Self Esteem Survey—Whole Group

Survey Section	Mean Score	N	Std. Deviation	P Value
Gen Self Pre Gen Self Post	38.70 39.55	40 40	10.74 9.89	 .397
Social Pre Social Post	12.05 12.65	40 40	3.85 3.90	 .183
Home Pre Home Post	11.40 11.90	40 40	3.77 4.02	 .333
Academic Pre Academic Post	11.90 11.65	40 40	3.73 3.62	 .606
Total Pre Total Post	74.10 75.75	40 40	18.23 16.91	 .340

Figure 1. Self Esteem Survey—Whole Group Scores



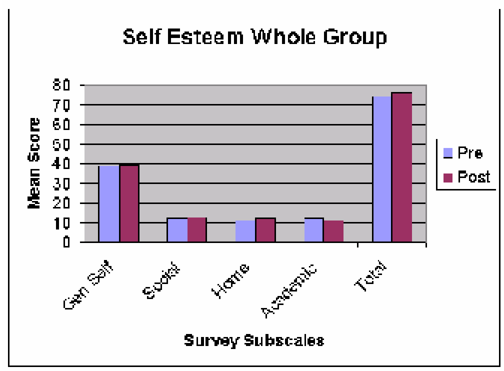


Table 2.
Self Esteem Survey—Males

Survey Section	Mean Score	N	Std. Deviation	P Value
Gen Self Pre Gen Self Post	40.82 42.64	22 22	11.14 9.10	 .121
Social Pre Social Post	12.18 12.18	22 22	4.32 4.32	 1.00
Home Pre Home Post	12.91 13.00	22 22	2.94 2.81	 .847
Academic Pre Academic Post	12.63 12.00	22 22	3.29 3.55	 .246
Total Pre Total Post	78.64 79.82	22 22	18.21 16.21	 .456

Figure 2. Self Esteem Survey Males

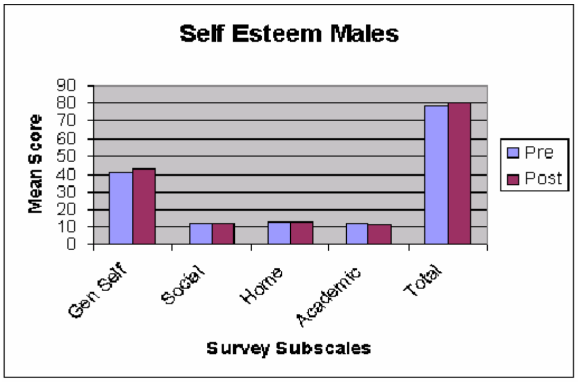
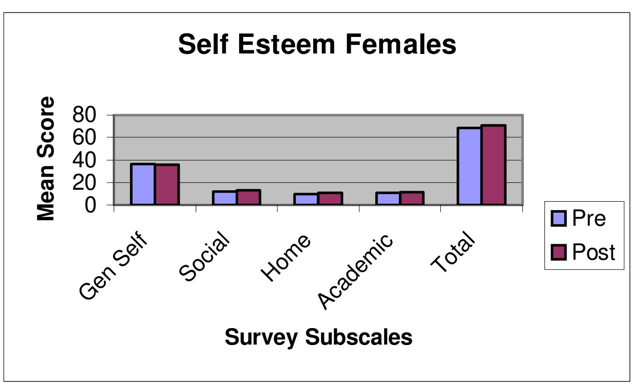


Table 3.
Self Esteem Survey—Females

Survey Section	Mean Score	N	Std. Deviation	P Value
Gen Self Pre Gen Self Post	36.11 35.78	18 18	9.93 9.75	 .849
Social Pre Social Post	11.89 13.22	18 18	3.32 3.37	 .062
Home Pre Home Post	9.56 10.56	18 18	3.81 4.89	 .325
Academic Pre Academic Post	11.00 11.22	18 18	4.13 3.77	 .798
Total Pre Total Post	68.56 70.78	18 18	17.15 16.85	 .515

Figure 3. Self Esteem Survey Females



When males were compared directly to females on the subscales using an independent samples t-test (General Self, Social Self-Peers, Home-Parents, and School-Academic), significant differences were found on the General Self Esteem posttest scores and the Home-Parents pre scores (tables 4 and 5).

Table 4. Self Esteem—
Males and Females Pre Surveys

Survey Section	Mean Score	N	Std. Deviation	P Value
Gen Self Pre Gen Self Pre	40.82 36.11	22 18	11.14 9.93	 .166
Social Pre Social Pre	12.18 11.89	22 18	4.32 3.32	 .810
Home Pre Home Pre	12.91 9.56	22 18	2.94 3.91	 .005
Academic Pre Academic Pre	12.64 11.00	22 18	3.29 4.13	 .182
Total Pre Total Pre	78.64 68.56	22 18	18.21 17.15	 .080

Figure 4. Self Esteem Survey Males vs. Females Pre Scores

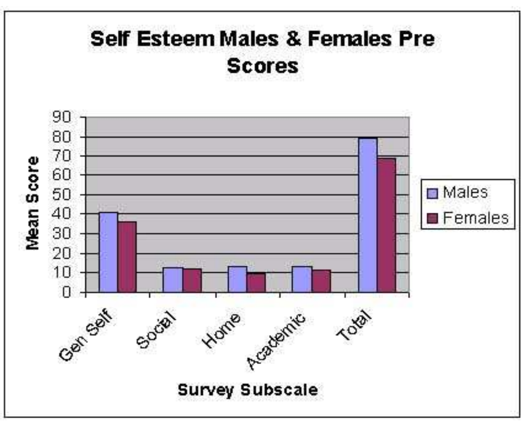
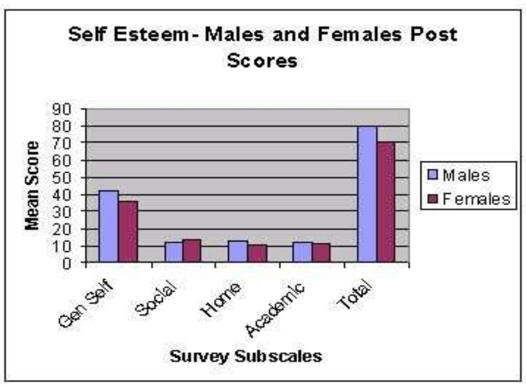


Table 5. Self Esteem—
Males and Females Post Surveys

Survey Section	Mean Score	N	Std. Deviation	P Value
Gen Self Post Gen Self Post	42.64 35.78	22 18	9.10 9.75	 .029
Social Post Social Post	12.18 13.22	22 18	4.32 3.38	 .397
Home Post Home Post	13.00 10.56	22 18	2.81 4.89	 .071
Academic Post Academic Post	12.00 11.22	22 18	3.55 3.77	 .509
Total Post Total Post	79.82 70.78	22 18	16.21 16.85	 .095

Figure 5. Self Esteem Survey Males vs. Females Post Scores



Science Museum Survey Results

For the Science Museum Survey data, the Wilcoxson nonparametric test for related samples was used to analyze the Likert scale data. Analysis of the Science Museum survey showed statistical significance on individual survey questions. All 28 questions were analyzed individually. The whole group (n=41) analysis yielded statistical significance on questions 14, 16, 17, 18, and 19, all of which are in the *Science and Me* section of the survey (table 6). When separated by gender, the male group (n=23) showed statistical significance on questions17, 18, and 21, two questions being on the *Science and Me* section and one question on the *Science at the Center* section of the survey (table 7). The female group (n=18) showed statistical significance on questions 6, 7,10, 16, and 19, which have the most diversity of survey sections including *Science*, *Scientific Research and the Community*, and *Science and Me* (table 8).

Table 6.
Science Museum Survey—Whole Group

Question	Negative Ranks	Mean Rank	Positive Ranks	Mean Rank	Ties	P-Value
1	9	8.67	7	8.29	25	.591
2	11	9.95	7	8.79	23	.285
3	13	12.69	10	11.10	18	.406
4	6	7.67	9	8.22	26	.398
5	16	12.63	11	16.00	13	.750
6	18	14.89	10	13.80	13	.129
7	17	13.06	8	12.88	16	.091
8	15	12.83	12	15.46	14	.931
9	9	12.00	14	12.00	18	.347
10	12	17.67	18	14.06	10	.666
11	14	12.57	14	16.43	12	.532
12	12	11.54	11	12.50	17	.988
13	14	12.29	12	14.92	14	.927
14^	10	7.15	3	6.50	27	.055
15	11	12.09	13	12.85	15	.605
16*	14	11.07	5	7.00	20	.011
17*	9	9.83	16	14.78	14	.043
18*	9	10.17	17	15.26	14	.027
19*	6	13.33	21	14.19	14	.007
20	13	15.00	13	12.00	15	.607
21	6	13.75	17	11.38	18	.081
22	9	11.94	14	12.04	18	.336
23	14	12.50	8	9.75	19	.099
24	9	13.33	14	11.14	18	.575
25	12	17.42	17	13.29	12	.847
26	12	11.08	11	13.00	18	.877
27	16	13.94	9	11.33	16	.093
28	15	15.90	16	16.09	10	.851

Summary of Statistically Significant Differences between Whole Group Pretest and Posttest Responses

Item	*After the Program, Students Were More Likely to Respond*
14	Science is not interesting to me
16	I don't feel confident talking about scientific topics w/friends
17	I use science to help solve practical problems around the house
18	I can use science to explain how or why things happen
19	When making decisions about my health I take account of scientific information

Table 7.
Science Museum Survey—Males

Question	Negative Ranks	Mean Rank	Positive Ranks	Mean Rank	Ties	P-Value
1	5	5.6	5	5.4	13	.957
2	5	6.2	4	3.5	14	.298
3	8	6.69	4	6.13	11	.249
4	4	5.63	6	5.42	13	.589
5	10	7.05	6	10.92	7	.895
6	7	9.00	8	7.13	8	.861
7	8	8.44	7	7.50	8	.659
8	4	4.88	8	7.31	11	.118
9	5	6.40	6	5.67	12	.928
10	9	11.61	9	7.39	5	.401
11	11	8.18	7	11.57	5	.841
12	6	6.83	7	7.14	10	.748
13	9	8.17	8	9.94	6	.884
14^	6	4.00	1	4.00	16	.079
15	6	8.75	9	7.50	7	.637
16	7	6.71	4	4.75	11	.185
17*	3	3.83	9	7.39	11	.029
18*	5	7.30	12	9.71	6	.050

19^	3	6.50	10	7.15	10	.066
20	7	7.93	7	7.07	9	.842
21*	3	7.33	11	7.55	9	.047
22	3	7.67	8	5.38	12	.358
23	8	7.63	5	6.00	10	.244
24	4	8.25	9	6.44	10	.373
25	6	10.00	9	6.67	8	1.00
26	7	6.86	6	7.17	10	.859
27	10	7.45	4	7.63	9	.161
28	7	7.36	10	10.15	6	.234

Summary of Statistically Significant Differences Between Male Pretest and Posttest Responses

Item	*After the Program, Students Were More Likely to Respond*
17	I use science to help solve practical problems around the house
18	I can use science to explain how or why things happen
21	Science at the center is easy for me to understand

Figure 6. Science Museum Survey Science Section—Males

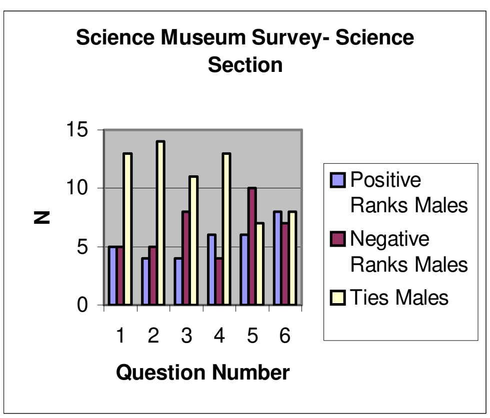


Figure 7. Science Museum Survey Scientific Research and the Community

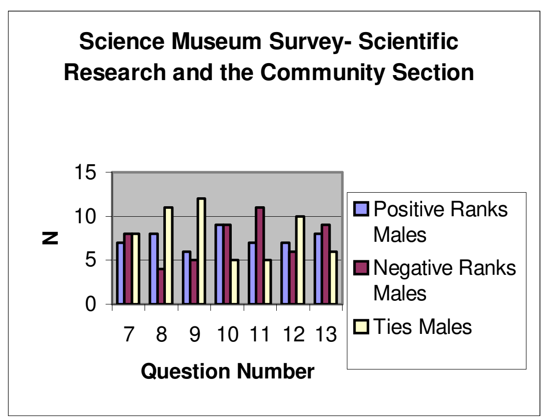


Figure 8. Science Museum Survey—
Science and Me

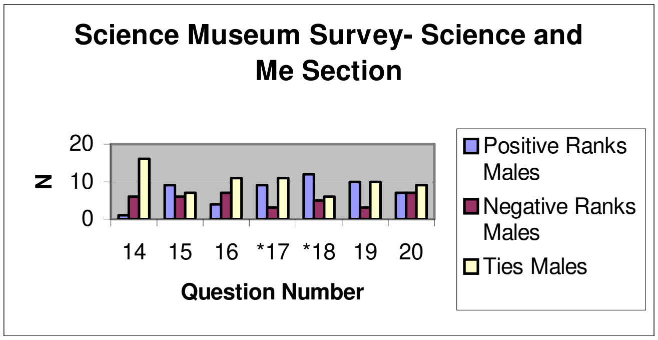


Figure 9. Science Museum Survey—
Science at the Center

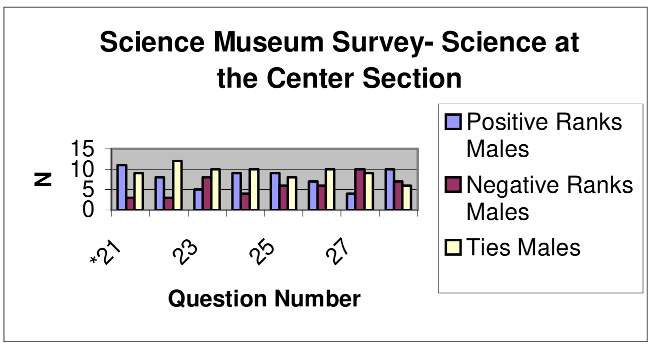


Table 8.
Science Museum Survey—Females

Question	Negative Ranks	Mean Rank	Positive Ranks	Mean Rank	Ties	P-Value
1	4	3.25	2	4.00	12	.595
2	6	4.42	3	6.17	9	.631
3	5	6.40	6	5.67	7	.928
4	2	2.50	3	3.33	13	.480
5	6	6.33	5	5.60	6	.650
6*	11	6.82	2	8.00	5	.034
7*	9	5.56	1	5.00	8	.013
8^	11	8.23	4	7.38	3	.072
9	4	5.88	8	6.81	6	.208
10*	3	4.33	9	7.22	5	.032
11	3	6.00	7	5.29	7	.329
12	6	5.42	4	5.63	7	.602
13	5	4.60	4	5.50	8	.952
14	4	3.75	2	3.00	11	.317

15	5	3.8	4	6.50	8	.672
16*	7	4.71	1	3.00	9	.030
17	6	6.33	7	7.57	3	.586
18	4	3.50	5	6.20	8	.298
19*	3	7.50	11	7.50	4	.049
20	6	7.67	6	5.33	6	.575
21	3	6.33	6	4.33	9	.672
22	6	5.67	6	7.33	6	.685
23	6	5.33	3	4.33	9	.250
24	5	5.70	5	5.30	8	.917
25	6	8.17	8	7.00	4	.819
26	5	4.80	5	6.20	8	.715
27	6	6.83	5	5.00	7	.449
28	8	9.00	6	5.50	4	.213

Summary of Statistically Significant Differences between Female Pretest and Posttest Responses

Item	*After the Program, Students Were More Likely to Respond*
6	Science has the answers to all problems
7	Only scientists benefit from their research
10	It is not likely that scientific knowledge will be misused
16	I don't feel confident talking about scientific topics with friends
19	When making decisions about my health I take account of scientific information

Figure 10. Science Museum Survey
Science Section Females

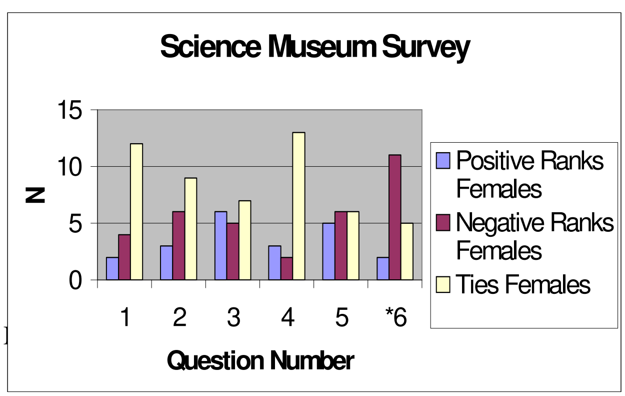


Figure 11. Science Museum Survey
Scientific Research and the Community

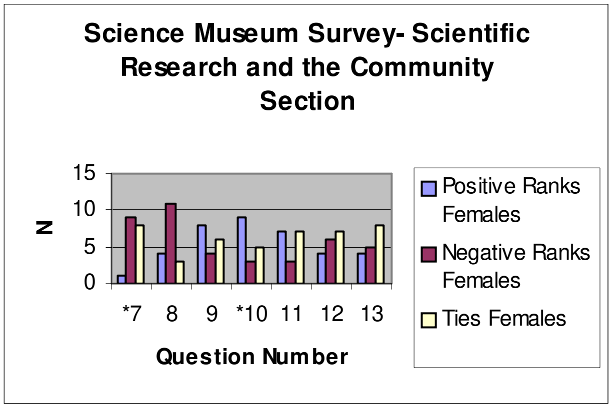


Figure 12. Science Museum Survey
Science and Me

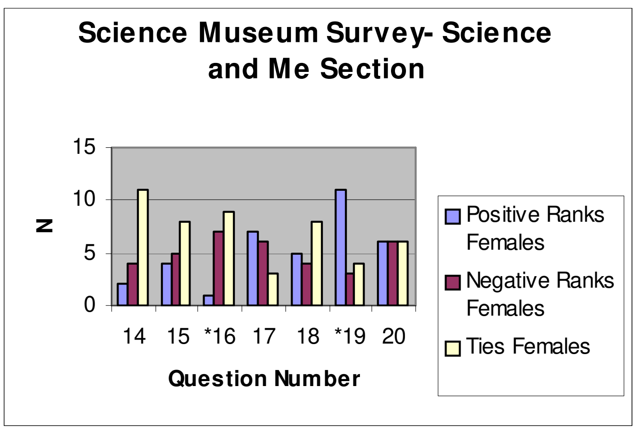
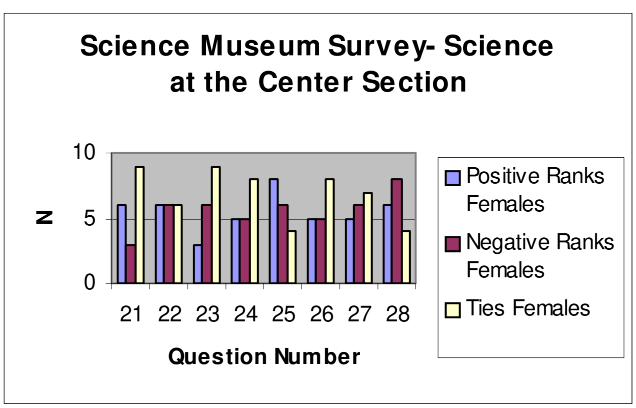


Figure 13. Science Museum Survey
Science at the Center



Qualitative Methods

In the second phase of data collection eight students were selected to participate in a focus group interview. Inclusion of this focus group allowed students to voice their perceptions of the program in their own words. Questions focused on how the service learning experience affected student self-confidence, job readiness, and views of science (at school and in the museum) after completion of the Rising Stars program.

The qualitative research in this study was fundamentally interpretive. The focus group interview was transcribed and then analyzed for themes. It should be mentioned that the qualitative data for this study was analyzed for major themes realizing that this information was being processed through the researcher's personal worldview. The researcher's background, potential biases, and experiences should be noted as he is the coordinator of the Rising Stars program at the Oregon Museum of Science and Industry. This will help authenticate the research and help the reader gain a fuller understanding of the qualitative nature of the study.

The focus group was an opportunity for these students to voice their thoughts and feelings about their experience in the Rising Stars program. Although the Coopersmith SEI surveys in many ways offered only limited support of the hypothesis that the service learning program would increase self-esteem, many of the responses generated from the focus group were very enthusiastic about the experience. When asked if science learned in the museum is different than science learned at school, one student echoed the feelings of several other students by saying about the museum, “I think it’s a lot easier and more fun hands-on. Some people might like to read textbooks, but I like to do hands-on stuff.” Another student said about their museum experience that they think science is “put into more real-life issues, and you can see how it actually works in a real environment instead of a classroom environment like a lab.” In general the students saw the science museum as a fun and hands-on environment that offers a more diverse set of subjects for them to learn. Several students did say however that they felt that one had to be dedicated to go out and ask staff educators questions and seek out information by visiting exhibits throughout the museum. They also felt that the museum portrays science in a more realistic way by showing real world applications unlike their perception of school science.

During the focus group students were also asked about the skills they gained through their experience in the Rising Stars program. Most of the students agreed that they feel more confident communicating with people and better able to deal with problems “unexpectedly thrown” at them as a result of their museum experience. Customer service skills such as becoming more organized, being polite to customers, and answering questions were mentioned by most of the focus group participants.

Several themes emerged from the focus group. When asked the question "What is your definition of science?" many of the students said that science is the study of "anything," including history. Nobody in the focus group thought of science as a process. Students saw OMSI as making science fun and hands-on compared to their science experiences at school, and many saw a higher potential for learning science at OMSI because they had access to many museum educators instead of one science teacher. They saw the exhibits in the museum as dealing with real life issues with applications to their lives. Students also felt their service learning experience improved their communication skills and they are more comfortable with public speaking.

Since the researcher and *Rising Stars* program coordinator led the focus group discussion, the question of bias arises in the student responses. The majority of student responses were positive and displayed enthusiasm for the program; however, there are examples of students providing direct responses when asked about ways to improve the program. When the students were asked about their group projects the general feedback was that they could have been better. One student said, "If you made us go more in depth then I think I would have gotten more out of it, 'cause we really didn't put that much effort into it." Another student remarked, "Maybe make it clear what we're supposed to be doing 'cause I found myself really lost." Several students also mentioned that their daily routine in their volunteer area became boring after a while. The addition of this type of feedback in the focus group discussion suggests that the students were willing to be honest with the researcher.

Observations of Rising Stars Training Classes

The weekly Rising Stars classes were another opportunity to observe what the students were being taught to prepare them for their volunteer work in the museum. Students attended six classes during the session and these were the only times that all students were together at once. Class topics included presentation skills, customer service, science inquiry, and being introduced to various museum staff that worked in different departments. Much of the content was not directly related to learning specific science content; instead the material was more focused on providing students with an overview of the museum and how to successfully interact with visitors. However, students were exposed to the concept of science inquiry on several occasions, indirectly when museum educators talked to students about topics relating to their lab areas and directly from one staff member who visited to explicitly discuss how science inquiry can be applied to their interactions with visitors. In an inquiry-based activity the museum staff member brought in three sealed milk cartons with each having different contents that the students were not allowed to look at. Instead they were put into groups and asked to determine the contents using observation and their senses. The museum educator likened the cartons to scientific models that scientists create as representations of nature. Students were then asked what methods or tools they would use to determine the contents of the carton. Responses ranged from the simple, such as weighing the carton to determine its mass and using magnets to see if the contents would be attracted, to more complex methods such as CAT scans, X-rays, and MRIs. The researcher, being the coordinator of the Rising Stars program, included explicit and implicit activities related to science inquiry as part of the treatment of students as well as their volunteer experience in the museum to determine if their overall experience in the program would change their views of science. Other class activities included "rate an exhibit," where students closely examined an exhibit of their choice to assess what age group the exhibit was intended for, how it incorporates hands-on science, and how the exhibit is educational. Students also did group projects, where they designed their own science related demonstration or activity while working together in small groups. Each group then presented their activity and was evaluated by the rest of the Rising Stars participants during the final class.

Researcher's Role and Study Limitations

This was a backyard study since the researcher conducted the research in his work setting. Therefore, various strategies of validity were used such as having outside observers of the students in classroom and museum activities and having the Rising Stars program assistant administering the pre and post surveys. Objectivity was always a primary goal when analyzing and interpreting the data, however, the reader should be aware of the potential bias that exists in such a situation. Since youth service learning programs take place in the museum, this was not a disruptive study.

However, staff members that worked with the students provided daily observations and feedback to the researcher that were used to help assess the students and the effectiveness of the service learning program.

Another limitation to this study lies in the one-group, pretest-posttest design. Several factors can occur in such a study design that can jeopardize the internal validity of the study. *History* refers to the events that occur in between the pretest and posttest that may have caused the differences in survey results. The effects of testing for a second time, in this case posttesting, has been shown to skew results in achievement and personality tests. *Maturation* is another variable that describes any biological or psychological change over time that affected the students between pretesting and posttesting. The three factors listed here can all potentially be the cause of pretest and posttest results instead of X being the cause. The most important limitation to the one-group, pretest-posttest design is the lack of a control group, thus Campbell and Stanley (1963) do not consider this a true experimental design. With this being said, Rennie et al. (2003) cites that control groups are difficult to find for research in informal environments.

DISCUSSION

The results of the data collected suggest that gender differences in self-esteem and views of science were present in the *Rising Stars* service-learning program. The results also suggest that there were differences in the findings between the quantitative and qualitative self-esteem data. The research goal of this study was to investigate if a science-based service learning program affected student self-esteem and changed students' views of science. The results of the quantitative data showed that within the whole group of students there were no significant differences in self-esteem between the pre and posttests. When the self-esteem data were analyzed using an independent samples t-test to compare males and females, significant differences were found in the General Self and Home-Parent subscales of the Coopersmith test. The Science Museum Survey results showed significant differences between pre and posttest scores on individual questions within the whole group and between genders. Contrary to self-esteem data gathered by the Coopersmith SEI, the qualitative focus group data were able to provide rich information in the students' own words and give multiple examples of how their experience in the Rising Stars program helped them in areas such as public speaking and presenting science information as well as improving their self-confidence. Students saw the museum as a place rich with scientific information that provided them with many opportunities to learn new information in multiple ways that differed from their school science experiences. Students also thought the fun and hands-on nature of the museum was beneficial to them and a positive environment in which to learn science.

The Science Museum's Impact on Views of Science

This research study leads one to question the role of science museums in society; are they to present a realistic view of research science or are they to stimulate interest, entertainment value, and excitement in people? Also important to determine is whether science museums are doing a disservice by presenting a "clean" and uncomplicated view of science, thereby projecting a false image of the scientific process to the general public. The results of the science museum survey were somewhat mixed and indicate that some common misconceptions about science were strengthened as a result of the students' museum experience. The results of the whole group analysis showed that students were more likely to respond that science has the answers to all problems, that only scientists benefit from their research, and that it is not likely that scientific knowledge will be misused. Furthermore, students were more likely to respond that they don't feel confident talking about scientific topics with friends and that scientific information was important to consider when making decisions about their health.

When the survey was analyzed by gender, males tended to respond to statements that indicate gains in confidence in their scientific understanding and abilities. Specifically, males were more likely to respond that they use science to help solve practical problems around the house, that they can use science to explain how or why things happen, and that science at the center is easy to understand. The results of the female surveys displayed significant differences between pretest and posttest responses that indicate lower self-confidence and common misconceptions about science. Females were more likely to respond that they don't feel confident talking about science topics with friends. Misconceptions about science were evident among female respondents who were more likely to agree with the statements: science has the answers to all problems, only scientists benefit from their research, and it is not likely that scientific knowledge will be misused. These results indicate that programs such as *Rising Stars* should make more effort to provide females with activities that can build their self-confidence around science.

The results of the Science Museum Survey indicate that further research is important for science centers worldwide when considering the images of science that people are taking away after their visits. More emphasis on portraying the nature of science in exhibits and controversies that sometime occur in science could lead to greater scientific literacy within the general public. Further research in science centers can delve deeper into different programs that are run by these institutions instead of just looking at a visitor's experience with floor exhibits. "Informal" science is being taught in a variety of methods such as through camps, outreach programs, and service learning programs. By investigating these informal science opportunities we will gain a more comprehensive understanding of the role that science centers play in society and how they are shaping our perceptions of science.

Improving Service Learning for Girls

Women are more likely than men to have negative attitudes about the significance of science in their daily lives and lower self-confidence in their ability to do well in science (Von Secker, 2004). The results of the Coopersmith self-esteem test revealed that the mean score on the girls' self-esteem surveys were ten points lower than their male counterparts. Likewise, the Science Museum Survey results showed that girls were more apt than boys to respond that they don't feel confident talking about scientific topics with friends. These results correspond to gender related research that shows that girls often have lower self-esteem than boys when it comes to science. Research has found that the decline in women's attitudes and interest in science really starts around age ten and continues through the high school years (Kahle and Meece, 1994). Dweck (1986) found that when compared to boys, girls often have less confidence in their academic abilities, lower achievement expectations, and less interest in challenging scholastic activities. According to Brickhouse et al. (2000) girls tend to feel alienated by science and view science as masculine, competitive, objective and impersonal—qualities that are at odds with our images of what girls are.

These findings point to the need for using more female-friendly curriculum when designing service learning programs to make girls feel comfortable in informal learning environments, especially those dealing with science. Hecht and Fusco (1995) found that girls are more interested than boys in areas of personal growth, caring for others, and improving their community. Service projects that incorporate these ideals, especially when combined with science, will ultimately benefit the experience of girls in these projects. Kahle and Damnjanovic (1994) found the use of inquiry-based science improved girls' attitudes towards science in general, even on more typical "male-oriented" subjects such as electricity. Findings such as these have implications when considering designing the science related service learning experiences for girls, especially for science museum staff where inquiry is one of the main educational tools used in these environments.

Nature of Science

Research has shown that students typically don't develop an understanding of scientific literacy and the nature of science (NOS) through their participation in school science (Bell et al., 2003). Science apprenticeships provide students with the opportunity to receive implicit and explicit messages about NOS and scientific literacy. After student participation in an extensive eight-week science apprenticeship, none of the 10 students were found to have "adequate understandings of the nature of science" (Bell et al., 2003). The focus group interview included questions that were focused on student views of science. Specifically, when students were asked their definition of science most responded that it was the "study" of anything, none of the students thought of science as a process. According to the National Science Foundation, Division of Science Resource Statistics (2002), approximately 70% of Americans do not understand the scientific process. This demonstrates that science museums can play an important role in scientific literacy by presenting a more realistic view of science and designing exhibits that show the process of science. This is also an important opportunity for science-based service learning programs such as Rising Stars to explicitly discuss NOS and provide students ample reflection time to absorb these messages.

The Need for More Appropriate Assessment in Service Learning

Through this research it is evident that there is a need to use alternative forms of assessment if researchers are to gain deeper understanding of what students gain from a service learning program and whether museum-based programs such as Rising Stars can meet John Dewey's four criteria of a "truly educative" project. A disconnect was evident in the analysis of the quantitative and qualitative self-esteem data. The quantitative Coopersmith survey generated modest increases in self-esteem scores among the male and female groups but displayed significant differences on only two subscale sections when males and females were compared.

The lack of significant findings correlates with several other studies on service learning that also used the Coopersmith SEI. Perry (1998) found no significant differences in self-esteem scores between a high school group of students who participated in service learning activities and a control group from the same school. Out of three groups involved in service learning projects, Wang et al. (1999) found significant differences between pre and post test scores in only one group with the

Coopersmith SEI. Johnson and Notah (1999) found no significant differences between pre and post scores using the Coopersmith SEI for eighth grade students involved in service learning projects. However, qualitative data from interviews and journal entries found that students were very enthusiastic about their service learning experiences and the author concluded, "…language may have been a barrier that distorted results of quantitative data."

The researcher of this study had similar findings as Johnson and Notah and concludes that the Coopersmith SEI is not an effective tool for measuring self-esteem in service learning experiences. Like the Johnson and Notah study, the qualitative data gathered from the focus group painted a different picture, as students were enthusiastic about their OMSI experience noting their newfound confidence when presenting information and interacting with others. The focus group also revealed interesting student viewpoints about the differences in museum science and school science that were not captured in the Science Museum Survey. The surveys used in this research were chosen due to their use in previous studies as well as being tested for their reliability and validity. However, one drawback that the researcher noticed about the surveys used, especially the Coopersmith SEI, is that they did not directly relate to the students' Rising Stars experience. Perhaps using the same line of survey questions and statements but changing some of the wording to make more direct connections to the students' service learning experience may have yielded more significant results.

Past researchers have noted common flaws in service learning research including the overuse of pre and post surveys and the use of self-reporting combined with the lack of experimental controls and theoretical bases (Billig, 2000). Referring to the challenges of obtaining learning outcomes in science museums, Rennie et al. (2003) pointed out several difficulties, including the difficulty of finding control groups for pretest-posttest designs and the need to choose, beforehand, measuring instruments that correspond to the intended outcomes, that limit the opportunity to measure unexpected or additional learning outcomes. Kezar (2002) noted, "Even studies that expand the set of outcomes examined tend with few exceptions to use a narrow set of methods, predominantly survey methodology."

Researchers in the fields of service learning and informal learning recommend alternative assessment methods. The use of longitudinal research designs, student portfolios, and naturalistic approaches to data collection, such as using conceptual maps, meaning maps, and semantic networks, have been recommended as methods of capturing experiential learning (Kezar, 2002; Rennie et al., 2003). Naturalistic methods draw from psychology, ethnography, anthropology, and cognitive science and help to provide researchers with a more multifaceted picture of learning (Rennie et al., 2003).

Potential Benefits of This Research

This data will be useful to educators hoping to provide students with effective service learning experiences and to community organizations that want to assess and make improvements to their existing programs. The research will also benefit future students by using the research to help improve the Rising Stars program and other similar programs. Goals associated with the Rising Stars program included: 1) preparing students for success in a job-related environment; 2) promoting enhanced science literacy in a non-formal learning environment; 3) providing students the opportunity to increase their public speaking and presentation skills; 4) using hands-on tools, demonstrations, and technology to increase students' knowledge of science and their ability to explain scientific concepts to others; and 5) thriving in a safe, collaborative, and fun learning environment. The benefits to educators and those who design service learning projects/programs include: 1) adding to the existing body of knowledge associated with service learning; 2) using a mixed methods approach that will obtain quantitative and qualitative data on student knowledge, attitudes, and beliefs in a museum-based service learning program; and 3) bridging this research to the service learning theories of John Dewey and current day research being done in this field.

Suggestions for Future Studies

This research study brought to light gender differences in self-esteem and views of science. Therefore, it is suggested that future research be done on how to enhance female self-esteem in service learning contexts. Von Secker (2004) noted that women are more likely to have negative attitudes about the significance of science in everyday life and poor self-concepts about their ability to do well in science. The addition of adult mentors to youth volunteers was implemented in the 2004 Rising Stars program. A study on how female mentors can be positive role models and affect the service learning experience for girls participating in the Rising Stars program is recommended. Seymour (1995) found that women enter SME majors in large part due to recommendations and support from family, friends, and high school teachers. Once in college, the lack of support from staff and advisors is one of the main reasons for women switching out of SME majors. Women often expect a personal (mentor-like) relationship with their professors, and, when they do not receive this in their "weed-out" courses, many lose confidence and self-esteem and decide to switch majors. Faculty lack of support is one of the key factors in women's decisions to change majors. The extreme competitiveness in classes is also a factor for many women who switch out of SME majors. Therefore, the opportunity to link girls to adult female mentors in science related activities is highly recommended.

Linking service learning experiences in non-formal environments to what students are learning in their school classrooms is a challenge for educators. Since students are partaking in disparate experiences to satisfy service learning school requirements, it is difficult for teachers to create direct connections to classroom curriculum. Students are gaining different types of knowledge and experience in both environments and having them see the value and connections will be a way to enhance the total educational experience for students. OMSI provides a school year service learning program for local high school students. A research study could be designed to test for specific science content using students in a class participating in the service learning program and a control group of students who would not participate in the service learning experience. This would be an opportunity to link science knowledge learned in a traditional classroom setting with science knowledge in an informal learning environment such as OMSI. The use of a control group would be easier to access during a school year study. Of course, these are but two recommendations for future research studies, but both would be insightful extensions to this current study.

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