A Preliminary Study of Career Education in Middle School

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ABSTRACT

This article reports a preliminary study on the Geosciences in Middle School, which was a career education program in the Southeastern U.S focusing on science based on Super's (1990) theory. The students (n = 80) were found to improve their interests in studying science, increase science knowledge, skills and awareness and highly satisfied with the program. Implications on career education programs in middle schools and research as well as limitations of the study were discussed.

Introduction

Career exploration programs for school students are beneficial to their academic and career development (Smith, 2000). However, almost half of the students who have completed vocation preparation programs said they did not have a career plan or no one helped them develop a plan of study (Southern Regional Education Board, 1998). The majority had not met with a counselor or their parents to plan for their studies. Such lack of counseling may have limited students' vision of career choices (Hager, Straka & Irwin, 2007). Therefore, career education should begin early (Arrington, 2000). Also, a survey of Oklahoma parents (n = 500) found that a majority of parents (54%) thought schools should begin to teach students about career options and opportunities in middle school compared to 28% in high school and 18% in elementary school (PGI Research, 1998). Almost 40% of the children surveyed started to talk to their parents seriously while they were in middle grades about careers or jobs after high school. This percentage was higher than others in any other range of grades. However, few studies were found addressing career education, including career development programs in middle schools.

Barriers to Career Education in Schools

Major barriers were found to providing career development programs in middle schools. First, lacking financial support at the middle school level is a major challenge. School districts are not capable of offering career education courses or implementing career developmental programs for middle school students. Second, the student-to-counselor ratio is still high, although improved in some areas. School counselors understand the importance of career development. However, the amount of time they can spend on this essential work is restricted by limited resources and other administrative duties. The school-community collaborative approach is proposed in the current study as a possible solution to this problem.

School-Community Collaboration (SCC)

School-community agency collaboration refers to formal arrangements between schools and the greater community to expand access for their students and clients to a variety of services for academically at-risk students and their families (Hobbs & Collison, 1995). Other terms for similar arrangements include “school-community collaboration” (Taylor & Adelman, 2000), “school-family-community linked services” (Keys & Bemak, 1997), “school-family-community partnerships” (Bryan & Holcomb-McCoy, 2007), “multidimensional system of services,” (Keys, Bemak & Lockhart, 1998), and “service learning” (Jones & Hill, 2001). Collaboration between schools and the greater community promotes academic success and preparation for a productive life.

The Need for Science and STEM Education

In the past ten years, more educational resources and attention have been focused on promoting science, technology, engineering and mathematics (STEM) education. The inability to bring more students into STEM fields, including the underrepresented such as students of color and low-income students, may result in long-term negative effects on economic prospects for the United States (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2011). The Educational Testing Service report on the future of the U.S. economy determined that if universities cannot admit more disadvantaged students and increase the diversity in university enrollment and graduation rates, the U.S. will lose many of its twenty-first century workers because most jobs in the future will require a college degree (Carnevale & Fry, 2000). Encouraging minority students to go to college could also cut poverty dramatically (Carnevale & Fry, 2000).

Undergraduate enrollment in geosciences shows the lowest diversity of any of the STEM disciplines. While minorities earn almost 15% of the total bachelor's degrees granted in science and engineering, they earn only 4.6% of all BS degrees in geosciences (National Science Foundation, 2004). Meanwhile, natural resource majors such as forestry, witness recent declines in overall enrollment, including that of minorities (Hager et al., 2007). Therefore, intervention is much needed now to enhance geosciences education in schools and increase enrollment in universities and participation in careers in geoscience and natural resource fields. Specifically, career development programs in middle schools should encourage participation of students of color. In the current study, the Geosciences in Middle School program was developed and implemented based on the SCC model; the study of this program is reported here.

Purpose of the Study

The purpose for the preliminary study was to examine whether students improved in interests in science, knowledge, skills, and awareness of science through the Geosciences in Middle School (GIMS) program.

The Program

The GIMS was a year-round career education program in an urban public school district in the Southeastern U.S. It was a collaborative funded program between researchers, middle school counselors, and science teachers. A cohort of about 40 students enrolled each year from 2007-2010. The program consists of career and science activities. The GIMS provides informal geoscience education not covered in the middle school science curriculum (NC Department of Public Instructions, 2003). Career education includes career groups, visits, talks, interviews, etc. Each career group meeting lasted for about three hours on Saturdays. The curriculum for the groups was based on concepts of Super's (1990) theory. Super (1990) proposes that children around the ages of 12 to 14 develop their capacities (abilities) and are in transition into exploration. Therefore, the GIMS program was designed to improve their geosciences knowledge and skills, as well as increase their knowledge in sciences fields and career planning. Career groups were developed in the program (Pyle, 2000). The career group for the GIMS students adopts a structured group approach. Structured groups are grounded in human development theory and based on the establishment of personal and caring relationship between the counselor and the student in a small group setting (Ting, 2008). The approach is goal-oriented, providing hands-on experiences and coping skills training (Ting, 2008). Structured groups in universities have been proven effective in helping students of color, low-income, and academically at-risk college students in choosing a major, staying focused on academic study, and in promoting academic success (Sedlacek, 2004; Ting, 1998; Ting, Grant, & Plenert, 2000). Therefore, the structured group approach may be effective for school students in promoting their academic and career development. In these groups, the school students can learn more about themselves and explore their career interests and values in order to develop new study skills and life strategies for academic success.

During the first meeting in fall, the career group themes were "bonding" and "understanding self." In the groups, the counselors first led the students in get-acquainted social games, such as "The You Nobody Knows," and "People are Different: Interview a Classmate" (Barry, 2005). The counselors next used a guided imagery exercise to help students explore their self-concept. The counselors discussed the imagery exercises by asking the students to share and explain the images. Then, the counselors helped students learn about the meanings and implications of these images. The students also worked on more interactive exercises to explore their self-concept. These exercises included: "Defining Who I am" and "Why are You Special?" (Barry, 2005).

The second and third career group meetings focus on career interests, abilities, values, developing career aspirations and goals, and increasing knowledge in geosciences and natural resources. Guided by their counselor, the students explored occupations in geosciences using occupation information sheets and materials from *O'NET* (Occupation Information Network;

http://online.onetcenter.org/), and the *Occupational Outlook Handbook* (http://www.bls.gov/oco/). The *O'NET* provides occupation information, skills, and the training required to pursue an occupation. The *Occupational Outlook Handbook* is a nationally recognized source of career information designed to provide valuable assistance to individuals making decisions about their future work lives. The students also took the Career Key (Jones, 2007) test online to find out their career interests. Students selected two to three occupations from about 25 sciences occupations on the worksheet to explore: finding out career information from online, answering questions to reflect if they were interested in any of the occupations, and conducting follow-up activities with the counselors in their schools. Also, the students were taught how to use the activities on DISCOVER-Middle School (online) (American College Testing, 2007). Then, they worked on it as homework.

Remaining career activities include a group meeting in the summer camp, visits to geosciences agencies, science museums, and talks by geosciences and natural resource professionals. The career group meeting focused on learning from role models and developing a tentative plan for their career choice. Cognitive behavioral exercises including role-play, coaching, and modeling were used in the structured groups. Based on "A Career Profile," (Barry, 2005), the students interviewed a family member or a friend who worked in science about his/her occupation. The students shared what they learned from the family member as a role model. Then, the counselor discussed career decision making and guided the students to develop next steps for their career choices.

Another component of the program was a science enrichment program which included geological field studies, geospatial technology skills (including geographic information system-GIS lab exercises and global positioning system-GPS field activities), and human impact on the natural environment. Program activities were held on Saturdays throughout the fall and spring, and a six-day summer program, ending with a student conference. The students were separated into small groups of eight to ten, led by the researchers, partner school teachers, and geosciences undergraduates.

Parents were a key component of the program. They were expected to commit to support their students: attending program orientation and student conference, assisting in completing student assignments at home, and helping at field trips and summer camp. Throughout the program, emails and newsletters were used to communicate with parents about the progress of the program. For example, at the summer camp, the students would receive a daily newsletter and took it home to share with their parents. The newsletter included learning/highlights for the day, pictures, and reminder for next day. Parent feedback was positive.

In the summer program, more science and career activities were conducted, including visits to the science museum and the Department of Transportation, integrated geological studies and geospatial technologies, impact of human activities on natural resources and environment, and integration of learning in the program. The students also finished up the activities on DISCOVER-Middle School (American College Testing, 2007). The final day of the summer camp was a student conference providing an opportunity for the students to use posters and computer laptops to display the outcomes of their geological and geospatial field studies and career learning. By holding this event on a Saturday morning, more teachers and parents were able to attend and learn what the students had accomplished.

Research Question

Our hypothesis was that the program could enhance students' interests, knowledge, skills and awareness in science. In the research, specifically, we asked:

1. Did the students improve their competence in science as measured by the SSEPS?
2. Did the students increase their interests in science as measured by the SSEPS?
3. Did the students improve their interests in research or other science-related careers as measured by the SSEPS?
4. Were the students satisfied with the program?

Method

Participants

One hundred and forty-six students including minority students enrolled and 128 students participated in this program from 2007-2010. Ninety-three students completed the fall program: the geoscience field trips, lab work, and career groups. Eighty students completed the year-round program, including the summer camp, a completion rate of 62.5%. They were included in the study. Student ethnicity in the study was: 51 Caucasians (63.7%), 14 African Americans (18.2%), 10 Asian Americans (12.7%), 4 Hispanics (5.1%), and 1 Native American (1.3%). The mean age was 12.6. Compared to the state census, there are 70.2% Caucasians, 22.6% African Americans, 4.8% Hispanics, 2.6% Asian Americans, and 1.9% Native Americans (US Census Bureau, 2010).

Instruments

The Student Science Education Program Survey (SSEPS; Burroughs Wellcome Fund, 2005) consists of 15 Likert scale items on student's self-reported interests, knowledge, skills, and awareness of science and science careers, an item on career fields interested, a few demographic questions, and an open-ended question for comments. It has been used to assess outcomes of science and career interventions by the funding agency and possesses good professional quality.

The science competence test was developed by the researcher based on the instructions on geological and geospatial technology field trips and laboratory works. It contains 10 items. Students receive one point for each correct answer, total 10 points.

The student satisfaction survey consists of eight items, which was developed by the project team with a rating scale of 1 to 5: 5 for very good, 4 for good, 3 for average, 2 for bad, and 1 for very bad.

Procedure

Data collection

Data were collected for the science competence test before the first science field trip in September and after the last field trip in November. At the end of the program in summer, the SSEPS and student satisfaction questionnaire were distributed to the students at the student conference, which were returned to the researchers immediately or by mail.

Results

Goal I: Improving students' competence in science

In year one, SSEPS (n = 25) results show that 84% of the students agreed or strongly agreed that they improved their understanding of science (item 1a), 76% agreed or strongly agreed that they feel better being able to learn science (item 1b) and they learned some things from the program that they can use in science class at school (item 1c). In terms of their pre-and-post science competence test (a focus on geoscience and geospatial knowledge), the results were not significant. The research team reviewed the test and concluded that the test might be too difficult for the students. The test was modified for future testing.

In year 2, overall, the students appear to have improved their competence in sciences. The SSEPS (n = 29) results show that 81.2% of the students agreed or strongly agreed that they improved their understanding of science (item 1a), similar to last year. In the study, 75% of the students agreed or strongly agreed that they felt better being able to learn science (item 1b), similar to last year and 87.5% said that they learned some things from the program that they can use in science class at school (item 1c), better than last year (76%). The research team also conducted another survey at the beginning and the end of the year-round program. This survey contains 10 items about geosciences and geospatial knowledge (covered in the field trips and laboratory works), it was found that the students improved their mean scores ($X_1 = 2.91$; $X_2 = 3.72$, $t_{31} = 2.51$ $p < .01$).

In Year 3, SSEPS (n = 16) results show that 81.2% of the students agreed or strongly agreed that they improved their understanding of science (item 1a), better than last year (75.8%) 75% agree or strongly agree that they felt better being able to learn science (item 1b), better than last year (69%) and 87.5% said that they learned some things from the program that they can use in science class at school (item 1c); about that same as last year (89.1%) . In terms of their geosciences and geospatial knowledge, the students improved significantly from pretest to posttest ($X_1 = 2.63$, $SD = 1.32$ vs. $X_2 = 4.69$, $SD = 1.347$; $t_{28} = 6.24$, $p < .01$) on a survey developed by the research team.

Table 1
Scores of Student Science Education Program Survey in Year One 2007-2008

Item	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
1a. This program helped me understand science better.	.0%	.0%	16.0%	72.0%	12.0%
1b. Because of this program, I feel better about being able to learn science.	.0%	4.0%	20.0%	64.0%	12.0%
1c. I learned some things in this program that I can use in science class at school.	.0%	4.0%	20.0%	56.0%	20.0%
1d. Because of this program, I think I am more aware of the importance of science in everyday living.	.0%	4.0%	28.0%	52.0%	16.0%
1e. I tell my family or friends about the things we do in this program.	.0%	4.0%	24.0%	52.0%	20.0%
1f. Because of this program, I am more excited about science.	4.0%	.0%	48.0%	36.0%	12.0%
1g. Because of this program, I think I have a better understanding of what scientists do.	.0%	.0%	8.0%	76.0%	16.0%
	No	Uncertain	Yes		
2a. Would you like to participate in another program like this?	8.0%	36.0%	56.0%		
2b. Would you recommend this program to a friend?	4.0%	32.0%	64.0%		
	Not good at all	Not good	Okay	Good	Very good

3. How would you describe yourself as a science student?	.0%	.0%	32.0%	40.0%	28.0%
4. How would you describe your interest in science before this program?	.0%	16.0%	44.0%	24.0%	16.0%
	Yes, more interested	Yes, less interested	No change		
5. Has this program changed your feelings about learning science?	56.0%	4.0%	40.0%		
	Yes, more science classes	No, fewer science classes	No change		
6. Has this program encouraged you to think about taking more science in the future?	48.0%	4.0%	48.0%		
	Yes, thinking more	No, thinking less	No change		
7. Has this activity encouraged you to think more about getting a job in a science-related career?	48.0%	4.0%	48.0%		

Goal 2: Nurturing students' enthusiasm for science

In Year 1, SSEPS results show that 64% of the students agree or strongly agree that they were more aware of the importance of science in everyday living (item 1d), and 72% of them would tell their families and friends about the program (item 1e). In addition, 48% of the students agreed or strongly agreed that they are more excited about science (item 1f). Also, 92% of the students agreed or strongly agreed that I have a better understanding of what scientists do (item 1g).

Year 2, the SSEPS results show that 75.8% of the students agreed or strongly agreed that they were more aware of the importance of science in everyday living (item 1d), this ratio is better than last year: 64%. Also, 58.6% of them would tell their families and friends about the program (item 1e), lower than last year (72%). In addition, 34.4% of the students feel that they may be more excited about science (item 1f), lower than last year (48%). Also, 75.9% of the students agreed or strongly agreed that I have a better understanding of what scientists do (item 1g).

In Year 3, SSEPS results show that 75% of the students agreed or strongly agreed that they were more aware of the importance of science in everyday living (item 1d), this ratio is similar to last year: 75.8%. Also, 68.8% of them would tell their families and friends about the program (item 1e), better than last year (58.6%). In addition, 62.5% of the students felt that they may be more excited about science (item 1f), almost double the ratio of last year (34.4%). Given the high ratio (about 43.8%) of the students who were little or not interested before the program, the increase was not large (item 4). Also, 75%% of the students agree or strongly agree that I have a better understanding of what scientists do (item 1g), which was similar to last year (75.9%).

Goal 3: Interesting students in research or other science-related careers

In year one, SSEPS results show that 56% of the students said that they were more interested in learning science after the program (item 5) and 48% of them said that they think they would take more sciences in the future (item 6) as well as they were encouraged to think about getting a job in a science-related career (item 7). 48% said no change and 4% said they would take fewer classes. Finally, 56% of the students said that they would participate in another program like this and 64% of them said that they would recommend this program to a friend over four of a five-point.

In year 2, SSEPS results show that 62.5% of the students said that they were more interested in learning science after the program (item 5), better than last year 56%. Also, 62.5% of them said that they think they would take more sciences in the future (item 6), higher than last year's ratio (48%). In addition, 37.5% of the students were encouraged to think about getting a job in a science-related career (item 7), somewhat lower than last year's figure 48%. Finally, more than half of the students (56.2%) said that they would participate in another program like this and may recommend this program to a friend. This ratio is similar to last year.

In year 3, SSEPS results show that 62.5% of the students said that they were more interested in learning science after the program (item 5), better than last year 48.3%. Also, 62.5% of them said that they think they would take more sciences in the future (item 6), higher than the first year's ratio (48%). In addition, 37.5% of the students were encouraged to think about getting a job in a science-related career (item 7), lower than the first year's figure 48%. Finally, more than half of the students (56.2%) of them said that they would participate in another program like this and may recommend this program to a friend. This ratio is similar to last year.

Student Satisfaction

Year 1: The results showed overwhelmingly positive responses to the program (See Table 2). Also, 100% of the students agreed or strongly agreed that they had a positive experience in the geological program. All satisfaction items' mean scores were over 4 out of a 5-point scale, except for GIS field trip (primarily GPS field activities) (3.87) and visits (3.43). By items, a range from 75% to 100% of the students expressed that the program elements were good or very good, including GIS lab (81.3%), two geological field trips (75% and 93.8%), geological labs (75.3%), geological program overall (100%) and summer day camp (75%) ; except for GIS field trip (68.8%) and visits (50%). For the summer day camp, 75% stated that it was good or very good. The remaining 25% rated neutral on this item.

Year 2, the results were similar to year 1, except that satisfaction for GIS field trip was higher (4.05 vs. 3.87), visits to sciences museums and geosciences agencies (4.23 vs. 3.43). One item recorded with a lower score: GIS lab (3.85 vs 4.13).

In year 3, the results were similar to the first two years, except that satisfaction for GIS field trip was higher (4.00 vs. 3.87), geological field trips (4.37 vs 4.25), and visits (3.87 vs. 3.43). A few item scores were lower: geological laboratory, geological program overall, and career groups.

Table 2
Student Satisfaction Mean Scores and Standard Deviation

	Year 1		*Year 2*		*Year 3*	
Satisfaction Items	*X*	*SD*	*X*	*SD*	*X*	*SD*
Geographical Information System field trips (primarily GPS field activities)	3.87	0.83	4.05	0.83	4.00	0.82
Geographical Information System labs	4.13	0.89	3.85	0.78	3.88	1.02
Geological fields	4.25	0.57	4.20	1.05	4.37	0.62
Geological labs	4.00	0.73	4.02	0.67	3.79	1.12
Summer day camp	4.12	0.80	4.06	0.83	4.06	1.06
Geological program overall	4.25	0.44	4.06	0.98	3.73	0.88
Visits to science and geoscience agencies	3.43	1.09	4.23	0.88	3.87	0.91
Career groups	4.13	0.74	4.13	0.93	3.89	0.89
n	32		32		16	

Discussion

The findings of the preliminary study suggest that the Geosciences in Middle School program improved students' interests, knowledge, skills, and awareness in science and science careers. The GIMS focuses on topics not covered in the middle school science curriculum (NC Department of Public Instructions, 2003).

The current study found that the students improved on their knowledge in science, science careers and career planning. In practice, middle school counselors may enhance students' knowledge about the world of work and career planning through similar career programs. School counselors should educate students about how to gather, understand, and apply information about self and the world of work as an important skill, basic to making informed career decisions (Ireh, 2000). Counselors themselves should be aware of different occupational tasks, especially in this information age, in order to be able to help students become familiar with the futures of different occupations. Also, it is important for practitioners to be sensitive about individual differences among students' aptitudes, achievements, interests, values, and personalities. In such situations, the counselor should accommodate for these differences with additional services and testing.

The results of the geoscience project appear to support the notion of Super's theory (Super, 1990). For example, over 80% of the students said to have improved their understanding in science, 75% to 92% of the students had a better understanding about what a scientist do, 61% to 75% of them were more aware of the importance of science in every day, and 56% to 62.5% of them were more interest in learning science of students reporting a greater interest in science after experiencing and exploring the geoscience program support Super's stance on the importance of exploration during adolescence and young adulthood. Students were provided with the opportunity to learn about a career area that may not have been unfamiliar to them prior to attending the program. After exploring and learning about the science field in a supportive and hands-on manner, students appeared to gain knowledge about themselves, including their interests, science field, and career planning.

The GIMS program consists of career development groups, which may enhance students' interests and knowledge in science careers. In a study on structure of school career development intervention, similar elements were found: career advising/tutoring, career day/career fair, curriculum-based intervention, and youth apprenticeship (Dykeman et al., 2003) .

The current study examined a career intervention adopting the school-community collaboration model among researchers, teachers and counselors and parents. Collaboration for career education has become common. Collaboration among school teachers and principals and community resources (such as visiting agencies and businesses) were found to be effective in promoting career development (Smith, 2000).

Teacher support is important. The teachers in the GIMS program attended the field trips as group leaders and helped the students in the sciences labs. School counselors worked with the students in career groups. Principals provided the administrative support such as access to students, registration, and student encouragement by attending the closing ceremony. This also confirms the effectiveness of using the school-community collaboration model for interventions (Bryan & Holcomb-McCoy, 2007; Hobbs, & Collision, 1995). Metheny (2008) found that teacher investment, positive regards on students, expectations, and accessibility were found to relate to student career development.

Parent support is also important in students' career development (Arrington, 2000; Metheny, 2008; Turner & Lapan, 2002). The GIMS program was assisted by parents. Parent factors, including their expectation and support, were found for distinguishing persisters and switchers in science and technology careers aspirations (Mau, 2003). Other factors found were academic deficiency, socio-economics status, parental expectations, math self-efficacy, and reading self-efficacy (Mau, 2003). These factors can be considered for future programs/studies. Psychosocial factors can also affect science interests such as self-concept, and locus of control (Mau, 2003).

Among middle school students, 29% to 43% of variance were found to explain vocational self-efficacy for all Holland themed careers (Keller & Whiston, 2008). Specifically, the following parent behavior explained student's career maturity: expressing interest in various teenage issues, encouraging the student to make own decisions, helping the student understand career tests results, and telling the student s/he is proud of her/him.

Limitations

A few limitations should be addressed here. First, the sample of the study (n = 80) was comparatively small; future studies should increase the sample size. Second, there is an attrition of 37.5 %. Most of the attrition happened at the summer camp. It appears as if some students could not complete the year-round program. After the first year of the program, a survey was conducted by mailing a short questionnaire to the parents whose students had dropped out. In reviewing the results, regarding not attending the summer camp, the parents mentioned late beginning time and conflicts with other summer plans. From year 2, the summer camp was moved up to begin from 8:30 a.m. and the camp dates were the first week after summer holidays began to avoid family travels/vacations. Second, the study was based on self-reported data. Interpretations of the current findings on changes of career and science interests should be cautious. Professional instruments of self and career development could provide more objective information. Third, the science competence test was a pretest-posttest study. A better method would be an experiment design comparing with a control group. Finally, more reliable information can be obtained if longer-term changes can be traced such as course grades, courses taken, and college majors chosen. Due to these limitations, the findings are preliminary and cannot be generalized to other students as a whole.

Conclusion

In summary, the preliminary study reported a career intervention that enhanced students' interests, knowledge, and skills in science, and science careers. The GIMS represents a new approach using the school-community collaboration model for career education. It focuses on integrating career development and science enrichment, it may be important in the era of a strong focus on STEM and sustainability education in our country. Few resources and little support were found in career education in public schools. Given the preliminary nature of the current study, this career education approach may be explored further as a possible solution and can be replicated in other areas/school systems.

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