미국교외학교 소수민족학생들의 과학과 수학 특별활동과 성취에 관한 연구 : "THE SCIENCE AND MATH FOR EVERYONE PROJECT"에 대한 특별 보고서

Extracurricular Science and Math Activities and Achievement of Minority Students in an American Urban School : A Special Report of THE SCIENCE AND MATH FOR EVERYONE PROJECT

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이 프로젝트는 미국의 소수민족학생들의 과학과 수학의 수행능력과 흥미를 갖도록 혁신적인 교육전략을 개발하기 위한 준 실험설계연구이다. 연구대상은 중학교 7학년과 8학년 학생으로, 과학과 수학에 흥미가 있고 성적이 우수하며, 신체적으로나 기능적으로 장애가 있고, 소수민족이고, 경제적으로 빈곤한 계층이며 여학생을 우선조건으로 실험집단 52명, 비교집단 28명이 무선표집되었다.

연구대상 대부분(72명)이 흑인이고, 나머지(8명)는 히스파니아인이다.

연구내용은 1) 방과후 학술활동 2) 사회적 기술활동 3) 현장학습 4) 가족지원 프로그램을 실험집단에 실시한 후 실험집단과 비교집단의 학업성취도와 실험집단의 자아개념과 프로젝트 활동에 대한 평가를 분석한 것이며, 다음과 같은 연구결과를 얻었다.

1. 학업성취에 있어서 실험집단의 과학성적(CRT)이 통계적으로 비교집단보다 유의한 증가를 보였고, 프로젝트의 목표를 초과달성하였다. 비교집단도 자연적 성숙효과로 증가를 보였으나 유의도는 실험집단보다 낮았다.
2. 학생들의 프로젝트에 대한 평가는 긍정적이었다. 프로젝트 목적과 명확성, 현장학습의 적절성, 게임이나 학술활동보다 현장학습의 선호, 특히 자아존중감 활동이 많은 도움이 되었다고 보고하였다.
3. 실험집단의 자아개념은 프로젝트 기간동안 통계적으로 유의한 증가를 보였으나 학업 성취와의 상관관계는 유의하지 않았다.

이상의 연구결과를 토대로 이 프로젝트의 한국적 상황의 적용에 대한 시사점을 얻을 수 있었다.

주제어 : 소수민족중학생, 과학 · 수학 특별활동, 학업성취, 자아개념

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This is a modified segment part of the final report of the Science and Math for Everyone Project, a special grant that was received by Norfolk State University for two years (from June 1997 to August 1999) from NASA Langley Research Center's Office of Education in the U.S.A. The Science and Math for Everyone Project was a quasi-experimental research/education intervention strategy developed to assist educationally underserved minority students in science and math areas in the middle school. The primary author of this report has been involved in the Project as Collaborating Specialist* from February 1998 to February 1999 and the secondary author as Project Coordinator for the entire project period. The purpose of this report is to (1) illustrate the educational intervention model and design, (2) describe extracurricular activities, (3) discuss educational outcome measures, and (4) assess their impact on self concept of the subjects.

I. Introduction

"Science and math are for everyone." This was proclaimed by influential American education initiatives. There have been several reports on this theme, *including Science for All Americans* (Rutherford and Ahlgren, 1994), The Handbook of Research on Science Teaching and Learning (Gabel, 1994), and America 2000: An Education Strategy (U.S. Department of Education, 1991). Yet, there are three most neglected populations in science/math educational programs for gifted students: they are individuals whose talents are not recognized or actualized because they are (1) disabled; (2) racially and culturally different from the mainstream student population; and/or (3) economically disadvantaged (Van Tassel-Baska, Patton and Prillaman, 1991). School districts frequently overlook these youngsters when identifying gifted youth for special science and math programs (Baldwin, 1995). Studies have shown that most students identified for special science and math programs come from above-average socioeconomic backgrounds (Sears and Sears, 1980; Van Tassel-Baska and Willis, 1987). Disabled, economically disadvantaged, and minority students are clearly underrepresented in programs for gifted students (Baldwin, 1995). Historically and universally female students have been underrepresented in science and math areas, while they have been overrepresented in arts, literature and humanities. In line with the NASA's long range mission for diversification of human resources in engineering, science and technology, the underserved minority students in this study were defined as (a) ethnic minority, (b) economically disadvantaged, (c) physically disabled, and/or (d) female students.

In order to promote high interest and performance of minority students in science and math, NASA funded a educational/research project at two middle school in 1997. Because of logistical problems, the project was carried out at one school adding more students from 7th graders for the 2nd year. This report pertains only the 1998-99 school year. The purpose of this report is to (1) illustrate the educational intervention model and design, (2) describe extracurricular activities, (3) discuss educational outcome measures, and (4) assess their impact on self concept of the subjects.

The self concept was added in the project

* This position is not a paid regular staff position, because the NASA policy does not allow official involvement in its funded project by any non-U.S. citizen and also the author was the Visiting Professor for only 12 month period at Norfolk State University.

because of different viewpoints on achievement and self esteem. Some study indicated self esteem and achievement levels were related to each other (Christmon, 1989; Glanz, 1993), while others claimed that there was no link between low self esteem and poor school performance (Gaskin-Butler & Tucker, 1995; Shokraii, 1996). A program, Teaching Excellence for Minority Student Achievement in the Science tried to build self esteem and achievement in science (Adenika-Morrow, 1995).

Others studied self esteem and mathematics achievement in relation to race, socioeconomic status and gender (Kohr, et al, 1987)

II. Research Design and Implementation

The project used a quasi-experimental design because voluntary participation was required and thus true random selection was not possible.

This design is depicted in the Table 1:

〈Table 1〉 Research Design of the Project

Group	Pretest	Intervention	Posttest
E	O1	X	O2
C	O3		O4

E : Experimental Group which received education and family interventions (X)
C : Comparison Group which received no intervention
Ox : Observation of respective group at different times

Independent variables in this project were (a) the education intervention and (b) family intervention and education intervention. The undergraduate social work interns (BSW) and the education interns from Norfolk State University worked closely as they together help students improve math and science performance. The social work interns from the master's program (MSW) of the University exclusively worked with parents. Family intervention was measured by parental participation in the project. Dependent variables were observed on (a) academic achievements (which included (1) science and math achievement scores on Criteria Reference Tests; (2) grades in science and math; (3) participation level in higher math course) and (b) self concept. In this design, major potential problems were identified as interactions between interventions and selection and also contamination and diffusion among students in different groups, thus possibly clouding net impact.

1. Sampling of Students

The criteria of middle school student participants were:

- Potential interest or good grade in science and math;
- Physical or sensory disability;
- Ethnic minority;
- Economically disadvantaged; and/or
- Female students.

From the school, students were nominated by the above criteria in order to construct study groups (and to supplement attrition students, if necessary) for the project. A total of 52 students participated in the project during the 1998-1999 school year. The 8th grade students were selected with the same criteria a year before and continued this school year.

2. Students' Profile

During the 1998-1999 school year, 52 students participated in the project at Lake Taylor Middle School, Norfolk, Virginia. Almost all students were African American (n=49; 94.2%) and the others were Hispanic (n=3; 5.8%). Similar to the previous year, there were more female participants (n=28; 53.8%) than male students (n=24; 46.2%). There were 32 seventh

〈Table 2〉 Student Participants as Experimental Subjects

	7th Grade	8th Grade	Total
Selection of criteria students	70	23	93
Letters to parents from principals	70		70
Returned parent's consent forms	29	19	48
Additional students	3	1	4
Participants in year-end recognition	32	20	52

〈Table 3〉 Demographic Information of Participants

		Experimental Group		Comparison	Group
Gender	Male	24	46.2%	15	53.6%
	Female	28	53.8%	13	46.4%
Race	African American	49	94.2%	23	82.1%
	Hispanic	3	5.8%	5	17.9%
Grade	7tn Grade	32	61.5%	14	50.0%
	8tn Grade	20	38.5%	14	50.0%

grade students (61.5%) and 20 eighth grade students (38.5%).

The larger proportion of female students in experimental groups than comparison group might indicate that the selection criteria had a skewing effect and/or more female students stayed in the project.

As selection measures of the 7th grade students, the Literary Passport Test (LPT) scores in math and reading were used. There was no statistically significant difference in Math (t=.66, df=44, sig=.51) and Reading (t=-.28, df=44, sig=.78) between groups. Comparison of grades in science and math, and Criterion Reference Test (CRT) in science between the experimental group and the comparison group indicated no statistically significant difference. Therefore both groups were fairly equivalent prior to the intervention.

3. Personnel Arrangement

In order to implement this project, the personnel were composed of (1) staff (Principal Investigator, Project Coordinator, Education Coordinator, Lead Teachers, Collaborating Specialist, Administrative Assistant, all on part-time basis), (2) interns (On doctoral social work intern, four graduate and four undergraduate social work interns, four undergraduate education interns, all as part of their field education requirements), and (3) an external evaluator (on contract).

4. Implementation of the Project

The project had four components of intervention: (1) After-school academic activities, (2) Social skill activities, (3) Field trip, and (4) Family intervention. After-school programs ran after all classes from 2:00 p.m. to 4:00 p.m. on Tuesday, Wednesday and Thursday, when the after-school activity bus was available. Students were encouraged to come to the program at least twice a week.

1) After-School Academic Activities

The education interns played main role to improve the students' academic performance and

〈Table 4〉 Comparison between Experimental and Comparison Groups At the Beginning of the 1998-99 School Year

	Experimental Group	Comp. Group	t	df	sig
LPT Reading Percentile	52.06	53.93	-.28	44	.78
LPT Math Percentile	70.41	66.93	.66	44	.51
CRT Science 12/98	37.32	31.93	.90	56	.37
1st Quarter Science Grade	2.50	2.59	-.31	53	.76
1st Quarter Math Grade	2.29	2.33	-.15	64	.88

to promote students' interests in science and math at the after-school program three days a week. Education interns worked on academic skill development and immediate performance improvements, consulting with the teachers. The Virginia Standards of Learning (SOL) manual was used as a guide to develop student plans. In order to enhance student interest and success, various equipment and materials were used such as computers, printers, digital camera, calculators, academic learning software packages, encyclopedia, dictionaries, and educational supplies that the project provided. The educational interns worked with small groups of students on the computers, familiarizing the students with various items in the chemistry lab and with the algebra programs.

The science activities were in line with Standards of Learning goals set forth by the Commonwealth of Virginia. The lead teacher and interns developed activities that were conducive to the project objectives. Students preferred to conduct science experimental activities, doing more hands-on experiments or making things. Many experimental activities were drawn from AIMS (Activities to Integrate Mathematics and Science). One of the major activities of the project was for the groups to create a small science project or develop a math project to be put on display at the Science and Math Fair. The students submitted ideas for the projects that they would like to create for their science fair. The education interns worked with the science fair project.

Another facet of the activities with the students was for them to receive assistance with any homework assignment. Parents attending the initial meeting felt that the home-work assistance should be included since their child would be remaining after school three days a week and would be arriving home later than usual. The first 30 minutes were spent for educational interns to help with homework when a group member was having difficulty completing an assignment in any of the academic subject areas.

All project students were encouraged to participate in the school's science fair. A special meeting for students and parents was held on November 17, 1998 to explain SRI (Scientific Research Investigation).

2) Social Skill Activities

The BSW interns assisted the students' groups in formulating rules for the group to abide by. The students identified the consequences for those who chose not to adhere to the group rules. The BSW interns kept a daily journal to reflect their observations regarding : (a) which activities produced positive results and which activities did not, (b) individual member responses, and (c) non-instructional factors affecting science/math classroom performance. The BSW interns observed the science and math classes of the group members and developed specific strategies to be utilized with the groups.

The BSW interns focused their intervention mainly on the following areas:

- Improvement of self esteem
- Personal relationships
- Value clarification
- Strength of students
- Individual counseling

BSW interns helped students to know and understand one another better outside of the instructional environment. Self esteem issues were addressed with the students through role playing, writing activities, word games, scenarios for discussion. During this self esteem activity, students had to stand and share why they felt that they had good self esteem. They appeared to be proud to share their thoughts about their high self esteem.

An activity on value clarification utilized conflict resolution skills as the students challenged each other. One teamwork activity focused on the strengths of each individual student. These involved students helping each other create an art piece (like a hanging calendar) which illustrated a specific strength and they had to explain it via oral presentation. Many of the activities selected have resulted in very positive responses. The BSW interns were right on target with the activities selected and the students demonstrated a positive response.

Several of the students had very specific issues to deal with which required individual counseling. The BSW interns worked individually with those students requiring counseling in the areas of poor impulse control, disrespect of others in group settings, inappropriate classroom behavior, and lack of respect for authority figures. Some teachers indicated that they had seen positive changes in these students. Students established very good working relationships with the interns.

Under the guidance of the BSW interns, the students developed a student pledge and selected an appropriate logo as part of their group affirmation. The pledge was as follows:"I believe that Science and Math are for all Americans. The Science and Math for Everyone Project is for me and us. I will aim for new horizons. I will motivate my mind and wish to be heard. I will believe in myself and others. I will do my best to participate in the Project."

3) Field Trips

Field trips were made to (1) the Virginia Marine Science Museum in Virginia Beach, VA. (2) the Jefferson Laboratory in Hampton, VA, and (3) the National Air and Space Museum in Washington, D.C.

On December 3, 1998, the students took a field trip to the Virginia Marine Science Museum in Virginia Beach, VA and explored different exhibits in small groups with the project interns. They enjoyed hand-on exhibits in different rooms. A special tour behind-the-scenes showed how the museum workers fed and took care of the animals. They viewed an interactive movie on salt water marshes and met the museum curator, Mr. Maylor White, who gave a presentation on careers working in a museum.

On January 26, 1999, a field trip was made to the Jefferson Laboratory in Hampton, VA., the main focus of which was to study the atom and figure out the structure of the nucleus. Students toured the facility and learned the main elements of the laboratory and various instrumentations. After the tour, students watched the effects of liquid nitrogen on different materials such as flowers, a ping pong ball, a racket ball, a rubber ball and balloons and enjoyed a hands-on experiment with tennis balls that represented the electron movement in the accelerator.

On March 23, 1999, thirty-six students visited the National Air and Space Museum in Washington D. C. Students noted how early African American pilots started their careers in other countries because of discrimination at home and how they integrated in the main stream of American scientific community. At the IMAX theater, two movies, "Cosmic Voyage" and

"To Fly" were watched.

4) Family Intervention Measures

Family intervention was incorporated in the project on the premise that parental roles and family environment are important ingredients for student success in academics, especially in science and math. MSW interns provided most family support to parents of the project participants. A Family Intervention Need Assessment was conducted by MSW interns and provided initial contact to build relationship with families. Family Assessment included information on student's school activities, home environment, family relationships and parental involvement in the student's school.

On parent-teacher conference day (October 12,1998), MSW interns met parents from their group individually because many parents came on their own schedule to meet teachers, although we announced the time to meet. There were 11 parents and/or grandparents of the 7th grade participants.

A parent workshop on November 17, 1998 was about the science fair project using the Scientific Research Investigation (SRI). Mrs. Arline, science department head teacher, explained the whole process of SRI to the parents. Mrs. Arline encouraged parents that Scientific Research Investigation was not difficult, using an experimental exercise of density computation and that they could help motivate their children to do a project. There were over twenty parents and students in attendance.

The monthly parent workshop resumed on

〈Table 5〉 Comparison between Pretest and Posttest

	1st Quarter	4th Quarter	t	df	sig
Experimental Group					
Science Grade	2.18	2.16	-.12	50	.91
Math Grade	2.29	2.58	1.61	47	.11
CRT Science (%)	37.41	45.95	-3.63	40	.01
Comparison Group					
Science Grade	1.72	1.94	.78	17	.45
Math Grade	2.33	2.28	-.20	17	.84
CRT Science (%)	32.54	38.77	-2.17	12	.05
Experimental Group					
7th Graders					
Science Grade	2.26	2.42	.80	30	.43
Math Grade	2.07	2.81	3.58	30	.00
CRT Science (%)	43.57	50.83	-2.07	22	.05
8th Graders					
Science Grade	2.05	1.75	-1.06	19	.31
Math Grade	2.71	2.18	-2.17	16	.05
CRT Science (%)	29.56	39.72	-3.41	17	.00
Comparison Group					
7th Graders					
Science Grade	1.70	2.00	.71	9	.50
Math Grade	2.00	2.30	1.00	9	.31
CRT Science (%)	35.50	37.33	-.52	5	.62
8th Graders					
Science Grade	1.75	1.88	.31	7	.76
Math Grade	2.75	2.25	-1.08	7	.32
CRT Science (%)	30.00	40.00	-2.45	6	.05

January 26, 1999. The workshops offered to parents information regarding college preparation and financial aid. We discussed the importance of developing good study skills as 7th and 8th graders and also talked about how strengthening these skills can improve students' academic performance in high school. Students are encouraged to maintain excellent academics and to get involved in community activities to mold them into eligible candidates for college.

The parents' workshop in February was scheduled for Stress Management, but due to an inclement weather condition, only interns showed up without any parents.

The March workshop was conducted on "Bridging the Communication Gap with Your Adolescent", starting with games and giving out Walkman radios and telephone gift certificates as prizes in tune with the communication topic. The workshop proceeded with describing parenting basic assumptions and then turned to the definition of adolescence, changes in adolescent's development (psychological, social and biological perspectives), and concluded with brainstorming and possible solutions. A handout was given to every parent which included "21 Ways to Tame Your Adolescent" and an article entitles "Living with Teens."

Ⅲ. MAJOR FINDINGS

1. Academic Achievements

The academic achievements in terms of improvement of math and science subjects were assessed between 1st quarter and 4th quarter as in Table 5.

For comparison of the 1st quarter and the 4th quarter grades, there was no statistically significant difference. However, math grades of 7th graders were improved 0.74 with statistical significance (t=3.58, df=30, sig=.00), while math grades of 8th graders were decreased significantly (t=-2.17, df=16, sig=.05). The 7th grade students might be more interested in the project as the first year participants.

For comparison of pre-test and post-test of standardized tests, Criterion Reference Test in science were used. Because the scores of Criterion Reference Test in math in December 1998 were not available for administrative reasons, comparison of math scores could not be performed. The mean of Criterion Reference Test in science of experimental group increased from 37.41 to 45.95 which indicated 8.54 increase (22.8%) with statistical significance. This was an increase of science score more than the set goal of the project (20%). However, the comparison group improved (6.23; 19.1%) as well with statistical significance. Both the experimental group (t=-3.63; df=40; sig=.01) and the comparison group (t=-2.17; df=12; sig=.05) improved substantially. This could be due to the maturation effects. Further analyses, however, showed that attainment rate of the experimental group was significantly higher than the comparison group as shown in Table 6 below. The data seemed to imply that students in the project, especially 7th graders, were learning faster than comparison group students were.

〈Table 6〉 Comparison of Differences (from 1st to 4th Quarter) of CRT Science (%) between Experiment and Comparison Group

	Experi. Group		Comparison Group	
	Difference	Sig.	Difference	Sig.
7th Graders	7.26	.05	1.83	.62
8th Graders	10.16	.00	10.00	.05
Total	8.54	.01	6.23	.05

〈Table 7〉 Students' Evaluation of the Project in April 1999 (n=30)

Statements	Strongly Agree	Agree	Somewhat Agree	Disagree	Strongly Disagree
Purpose of Project clear	20	3	4	3	0
Activities clarified purpose	11	4	9	4	2
Self-esteem activities helped	16	4	3	4	3
Educational activities helpful	10	7	6	4	3
Activities very informative	7	8	5	6	4
Science activities were helpful	8	7	4	7	4
Too much science*	3	1	0	10	4
Math activities were helpful	7	6	5	5	7
Too much math	5	1	1	8	15
Field trips were relevant	11	10	4	4	1

* Two students did not respond.

In the math program, some of the 7th graders would take an Algebra course in the 8th grade.

Nine out of 32 7th grade students (28.1%) in the experimental group would take Algebra next year while four out of 14 7th grade students (28.6%) in comparison group would take Algebra next year. There was no difference between experimental group and comparison group.

2. Students' Evaluation

In April 1999 the project students were asked to evaluate the program and eighteen 7th grade and twelve 8th grade students participated. A summary of the results indicated overall students' satisfaction with activities of the project when "somewhat agree" was included in agreeing category. A large majority (76.6%) strongly agreed or agreed that the purpose of project is clear but only a half agreed that activities clarified purpose. Twenty - one students (70%) agreed that field trips were relevant and self esteem activities were helpful (66.7%). Students expressed that the positive things they liked most about the project were field trips (n=20; 66.7%) and games and activities (n=13; 43.3%). Twelve students (40.0%) indicated nothing they liked least, although some students indicated sharing feeling with others, science activities, and meeting too often.

A couple of participants shared their experiences at the Year End Recognition Ceremony which was held on April 23, 1999 at Norfolk State University. One of the 7th graders shared the following:

The Science and Math for Everyone Project has been a great experience for me. I learned a lot from the games and other activities that were performed. The activities we played and learned from, I know, will help me in the long run such as math graphs, measuring and math counts. Also with science hypothesis, producers, and scientific charts, I really do/did enjoy this program and I think it is a good program for upcoming 7th and 8th graders. The program helped them build a positive self concept. I know that anyone that was failing at the beginning is now passing because our after-school program teachers are doing and did a good job of teaching us. I am very happy that I was accepted and hope to be accepted next year.

Thank you, thank you, thank you!

One of the 8th grade students wrote:

The Science and Math Project was an influence to me. The project has influenced me

because of some of the social activities and social work. For instance, it enhanced my self-esteem. One day we were talking about our ideas on role models and I could talk about my mom, dad, and sisters as my role model. I like math and I think the project could have been improved by providing more math related activities, instead of a lot of science.

The project has shown me how I can be more open and assertive and to have a high self esteem for myself. It also taught me that sometimes, a person can't always do things alone and it's nothing wrong with asking for help, no matter how stupid the question or task may be. Also that there are teachers and other people that are willing to go out of the way to help you, if you really want the help. Last, the project has also shown me how to express myself and to talk to others about something if I'm sad or if I just need someone to talk to. Thanks for your support when I needed it, especially, my family.

3. Self Concept

Since one's self concept has been assumed to be associated with his/her behavior and attitudes, including academic performance, self concept of the project participants and their improvement were assessed. However, self concept could not be measured for the comparison group because comparison group was anonymous as an individual and was not contacted as individual.

To assess the level and change of their self concept, the Piers-Harris Children's Self Concept Scale was administered to the project students in September 1998. Twenty-three 7^{th} grade students and ten 8^{th} grade students participated in the testing. The mean of T-score of the 7^{th} grade students was 66.00 with standard deviation 11.70 and that of the 8^{th} grade students was 67.60 with standard deviation 8.22. In April 1999, twenty-one 7^{th} graders and fourteen 8^{th} graders took the test. The mean of T-score of the 7^{th} grade students was 70.33 with standard deviation 10.48 and the mean of T-score of the 8^{th} graders was 73.71 with standard deviation 12.48. There were nineteen 7^{th} graders and eight 8^{th} graders who took both tests. The mean difference between these two tests was statistically significant for both 7^{th} graders (t=2.58; df=17; sig=.02) and 8^{th} graders (t=3.49; df=6; sig=.01). Even though such a remarkable improvement could not be exclusively attributed to the project activities because of the lack of data from the comparison group, students in the project significantly and universally improved their self-concept during the project period.

The correlation between self concept and academic scores was observed but there were no statistically significant relationships. The improvement in self concept and that of academic scores also indicated no statistically significant relationship.

Ⅳ. DISCUSSIONS

Educational outcome measures were relied on objective criteria which school provided for all students in order to control the reactive effect of comparison group when they were known on their comparison group status. Such object

〈Table 8〉 The Mean Difference between of Pre-test and Post-test of Piers-Harris Children's Self Concept Scale Scores

	Sept. 1998	April 1999	t	df	sig
7^{th} Graders	65.28	70.11	2.58	17	.02
8^{tn} Graders	67.00	75.71	3.49	6	.01
Total	65.76	71.68	3.87	24	.00

measures were grades in science and math, Criterion Reference Test (CRT) in science and math, and selection for higher math. There were important indications or evidences that the project indeed had positive impact on student performance in science and math in terms of partially meeting the goals of an average 20% increase in science. The former had not only higher CRT science percentages (in case 7th graders), but also had higher improvement rates than the latter.

However, when differences between the experimental group and the comparison group were compared to other measures, the net impact of interventions was not clear. In a few outcome measures, there were some mixed results suggesting that findings were inconclusive.

Self concept measure assessed by the Piers - Harris Children's Self Concept Scale clearly indicated that both 7th graders and 8th graders improved their self esteem with statistical significance. Even though a lack of comparison group data would not allow any reliable assessment of net impact of the project on their self concept, it was notable that students who participated in the project activities made significant improvement of their self concept as a whole.

This project had a modest success in terms of conceptualization, implementation strategy, and outcomes. The outcome findings in the area of academic achievement was minimal to mixed. The self concept improvement was an exception, even though it might be due to maturation and other extraneous variables. Overall, however, this project outcome has significant educational implications. The middle school years are an important stage in life for early adolescents to dream about their future with pre-career developmental tasks. At this stage, it is momentous to develop and cultivate keen interests and wild imaginations, proper attitudes and aptitudes, positive self esteem and self confidence, efficient study habits, supportive study environment, etc., inducing and motivating them to do better in science, math, and other "hard" subjects. This can be done by helping them to appreciate and enjoy "fun things" in life and by exposing them early to "big surprises" of the world we live in. Therefore the project like this one should focus not so much on the narrow and immediate improvement in grades, GPA, CRT, and other objective measures in science and math, as on broad and generic changes of students' interests and inclination for those fields requiring advanced science and math subjects.

Target population in this project, namely, ethnic minority, female, disabled and economically disadvantageous students are generally underachievers in science and math. However, the notion of "late-bloomers" or "hidden genius" should be always entertained. Their hidden or repressed talents and their undeveloped or unrecognized potentials should be cultivated and enlightened through consistent encouragement and rewards. Realistically, therefore, most activity objectives and format should be more remedial and supplemental in nature with individual attention rather than those of gifted or advanced programs. Also cultural diversity and individual variances should be carefully recognized, sensitized, and adapted in all program activities.

Finally, developmental tasks, learning processes, special needs of children and youth are universal beyond cultural, social, and racial boundaries. Therefore, experiences and findings of this project may have parallel implications in the educational context of Korea as well. The educational "elitism" dictated by cronyism, classism, sexism, and mammonism in the past several decades created a great needs for special intervention for educationally under - served population in Korea - the poor, physically handicapped, and female. They are great human resources, traditionally unrecognized, untapped and undeveloped. Diversification and proliferation of human resources and development, as advocated by NASA's long range mission, may be an urgent national agenda in Korea as she strives to advance in science and technology in

the new millenium.

Key words : minority students, extracurricular science & math activities, academic achievement, self-concept

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