The Effectiveness of Purdue GERI Program on Science Learning and Creativity Development of Korean Gifted Students

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미국 퍼듀대학 하계 GERI (Gifted Education Resource Institute) 프로그램에 참가한 한국 영재 학생들의 과학 학습과 창의성 개발에 대한 효과 분석

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국문요약

본 연구의 목적은 미국 퍼듀대학의 하계 GERI 프로그램에 참가한 부산 영재고등학교 학생들의 창의성 개발 학습에 대한 효과를 분석하는데 있다. 연구자들은 12명의 학생들을 대상으로 과학관련 수업을 참관하여 교사와 학생간의 상호작용 및 창의성 개발을 위한 교수학습 전략을 분석하였다. 그리고 이중 6명의 학생들을 대상으로 구체적인 과학 학습과 창의성 개발 과정에 대해 심층 면담을 실시하였다. 연구 결과, 3단계의 심화 학습으로 이루어진 GERI 프로그램은 교사의 창의적인 교수 방식 및 그룹 토의와 개별 연구를 통한 학습으로 학생들에게 창의적인 사고 기능을 촉진하는데 매우 효과적인 것으로 나타났다. 또한 면담을 실시한 대부분의 학생들은 영어에 대한 부담에도 불구하고 GERI 프로그램이 재미있고 쉽게 학습할 수 있으면서도 창의적인 사고 기능 개발에 효과적인 것으로 인식하고 있었다. GERI 프로그램은 우리나라와 비교할 때, 과학 지식의 수준이 다소 떨어지고, 체계성이 부족한 경향이 있었으나 학생들에게 다양한 학습 방법을 활용하여 새로운 과학 세계에 접할 수 있도록 도와주는 것으로 나타났다. 본 연구의 결과는 우리나라 영재 학생들의 창의성 향상을 위한 교수학습 프로그램을 개발하는데 의미 있는 시사점을 제공해 줄 수 있을 것이다.

Key words : GERI program, gifted students, creativity, scientific giftedness, gifted education

I. INTRODUCTION

The increasing interests in gifted education have spread out all over the world as its effect on global economies and the environment is highlighted. The emerging needs for gifted education have been acknowledged from two perspectives, the personal and national perspective (Park, 2004). From the personal perspective, gifted education helps maximize and maintain individuals' potentials and interest to the certain domains in which they have exhibited great talent and giftedness. While gifted students share characteristics and needs with other students, they have unique intellectual and psychological characteristics that are distinct from their nongifted peers such as the higher level of creativity and motivation (Park *et al.*, 2005).

In response to their unique needs, a variety of enrichment programs and curricular initiative have been

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developed to enhance the academic achievement and attitudes of school aged students. A meta-analysis of hundreds of evaluations of science-enrichment programs concluded that overall, they are effective in increasing science achievement substantially in gifted students (Pyryt *et al.*, 1993). One specific example of enrichment programs based on the Purdue Three- Stage Model was perceived by students and their parents to have had positive effects on most participating students' cognitive development (Moon *et al.*, 1994). This program has been successful in achieving program goals, such as helping student develop basic thinking skills, creative thinking skills, problem-solving attitude, independence, and motivation.

From the national perspective, it is inevitable for a developing country like Korea, as a nation mostly depending on advanced development of science and technology for its growth and economic competitiveness, to invest in developing quality gifted education programs (Park, 2004). Korean gifted education which has particular interests in Mathematics and Science has focused on creativity development in gifted students since the creativity in Math and Science is linked to fiscal prosperity and competition within the global economy (Park, 2004). The establishment of Busan Science Academy for gifted high school students is a good example of the effort (Park, 2004). This effort has increased the number of students who are identified as the gifted and enrolled in the gifted program as well as public awareness of the importance of gifted education. As an part of this effort, Busan Science Academy have provided students with an opportunity to have international education experiences in developed countries including U.S.A. to have favorable influences on students' academic and creativity development. It is a substantial amount of investment from the government; however, it is still unknown whether this international gifted education program is effective in academic, especially creative development in Korean gifted students because of the lack of research examining the effect of these programs.

Therefore, the present study aims at examining the effectiveness of the summer enrichment programs based on Purdue University GERI (Gifted Education Resource Institute) program in U.S.A. on students' creative development from the participants' perspective. To gain a clearer and more comprehensive picture of their experiences and impressions of the program effects on their creativity development by comparing their experiences in their home school science class and the GERI program, semi-structured individual interviews were conducted. In addition, effective strategies the students use for their own creativity development were identified. This endeavor is important and meaningful to both Korea government, which supports this international education program and continues to build extensive gifted programs, and Purdue GERI program. For Korean government, international gifted educational strategies need to be evaluated for how well they can meet the unique needs of Korean students so that Korean government can decide to further invest on this program. For the GERI program, by evaluating the effectiveness of the program, it will improve the quality of the program to fit students' needs and interests.

II. LITERATURE REVIEW

1. Effectiveness of Science-enrichment Programs

Within many enrichment programs, there are a number of strategies and structures as components of gifted education programs that appear to be effective in facilitating the upper level of learning and abilities of the gifted students. First, in terms of strategies, consistent with national standards for science education (National Research Council, 1996), many programs that found to be successful have emphasized inquiry-based, participatory learning and hands-on laboratory activities. For example, one study examined the effects of an integrated, hands-on mathematics and science curriculum, Georgia's Project for Gifted Education in Math and Science (Ga-GEMS), on the academic achievement of gifted high school student (Tyler-Wood *et al.*, 2000). The researchers in this study suggest several components involved in the curriculum which have influenced

the achievement level of secondary gifted students: superior teachers' team teaching approach, blocked scheduling that permits extended hands-on laboratory time and field trips, and homogeneous grouping. Peer collaboration appeared to be another strategy of facilitating learning in and giving affective benefits to gifted students as well (Diezmann & Watters, 2001). The students were motivated to collaborate with peers only when the task is challenging that require high level cognitive engagement. However, collaboration with and observation of peers provided students with a supportive learning environment that assists them with overcoming obstacles within a task and promotes the development of confidence and self-efficacy.

The forms of gifted education programs in the schools vary in their potential to meet these unique needs; pull-out program, full-time program, and supplementary summer school programs. Among these programs, short-term summer school program employ fast-paced intensive curriculum, faculty who are specialists, interaction with others of similar ability, and a supportive climate for growth (Kolloff, 1991). One pilot study assessing the effectiveness of summer intensive science courses for gifted students found that the program was successful in increasing the students' conceptual understanding of basic concepts and was roughly equivalent to that or ordinary-length high school courses (Hsu, 2003). Another study examined the impact of summer residential program developed based on the Purdue Three-Stage Model from students' perspective and found that this program successfully met the students' needs in academic, social, and psychological areas (Enerson, 1993). For example, this program meets the academic needs of the participating gifted students through providing challenging tasks, exciting discussion, and real-life experiences. Many participating students also expressed the happiness of finding people with whom they felt understood and share themselves.

These two aforementioned studies are particularly informative and provide in-dept knowledge on the program since they evaluate the effectiveness of the program from the participating students' views using qualitative research methods. With a qualitative method, we would understand the program's story by capturing and communicating the story of participating students in more accurate language (Patton, 2001). Understanding both stories of the program and participants may be useful to the extent that they reflect the processes and outcomes of the program for those who must make decisions, improve program effectiveness, and inform decisions about future programming. In addition, viewing the effectiveness of the program from the students' perspective is important because of large individual differences in program responsiveness among participants (Tassel-Baska & Kulieke, 1987). Gifted students are a diverse population. When the gifted students were provided opportunities to experience science firsthand, some increased their confidence and motivation for the scientific inquiry and process whereas others were disappointed, finding it less useful and rewarding than they expected. Therefore, it is important to consider the needs of the individual students taking their perspectives.

2. Creativity Development through Gifted Education Programs

Fostering creative development is one of the prime goals of most gifted education programs. For example, although, given the situation of lack of a solid foundation and effective gifted educational system yet, the creativity component has not been taken into account in the student selection process, the gifted education reform in Korea clearly states that creativity development of gifted students is the most important goal of gifted education program (Korean Educational Development Institute, 2003).

Despite the wide awareness of importance of creative development in this field, there is paucity of research that examines what strategies work well in developing creativity of students with scientific giftedness with a few exceptions (e.g., Davis, 2004). According to Davis (2004), the most commonly used teaching strategies for creative development is to involve students in creative activities and projects, including individual and small group projects. Several researchers have expressed difficulties using existing literature for pro-

gram evaluation. While the field of gifted education has advocated evaluation as central part of program development for many years, there is little study effort to provide insights on what works and what does not work in gifted education programs (as cited in Avery & VanTassel-Baska, 1997, p. 125). Therefore, further research is required to identify and provide effective educational strategies for the development of creativity in gifted students.

3. Research Questions

1. How do Korean gifted students learn science in GERI program?
2. How is their creativity developed?
3. What aspects of the GERI science class experience do Korean students perceive as similar to their home-school science experience and what aspects are perceived as different?

III. METHOD

1. Participant

Among eighteen Korean gifted high school students enrolled in at least one science-related class in the Purdue GERI summer program, twelve students who had returned both the parent consent form and student assent form were included in this study. Researchers observed them during class (from June 21 to 30, 2005). Among them, six students were selected for interview. Two out of six students interviewed were female students. The students participating in the study were all freshmen in high school aged from 15 to 16 years old. All the students came from Korean gifted science high school, Busan Science Academy, known as providing high quality education for gifted students.

The GERI summer program based on Purdue Three Stage Model was a two-week residential enrichment program for gifted students with a great emphasis on creativity development. They recruited student participants international-widely as well as domestically. Three science-related classes were offered to the students: biochemistry, forensic science, and medical biology. The GERI program involved two class sessions (morning and afternoon), individual study sessions, extracurricular activities, and field trips. Most of the teachers working on this program were graduate teaching assistants who majored in the subject they taught. One female teacher taught forensic class while teachers for biochemistry and medical biology were males. They all participated in the study.

2. Procedure

All Korean students enrolled in a science related class were asked to participate in the research. Purdue research team mailed consent form package via airmail to Busan Science High School. Their Korean teachers unanimously collected the parent consent forms and student assent forms from the students. A Korean guide teacher brought them back to GERI program. In addition, the GERI science teachers were asked to participate in study. The consent forms were collected from the teachers as well.

Two data collection procedures were employed. First, the major method for answering the research questions was to conduct face-to-face individual interviews with six Korean gifted students. During the second week of the students' camp experience the researcher interviewed six participants using a semi-structured interview protocol. A total of six Korean students, three students from biochemistry class and three students taking both medical microbiology and forensic science, were interviewed. The graduate student interviewer contacted the students individually and scheduled the interview. During free time, the interviews on students' learning process in GERI program were conducted in the lobby of the dormitory where they stayed. The average interview took 32 minutes with a range from 26 to 37 minutes. Interviews were tape-recorded and transcribed for analysis.

Second, twelve Korean students and their GERI science teachers who retuned consent forms were observed by three researchers while engaging in their science class experience with an emphasis on teacher-students interaction and teaching strategies. The researchers observed each science class 2～3 full class ses-

sions. During the observation sessions, the observers took a note about what they observed as well as used the GERI Teacher Observation Sheet. This observation form included specific items to rate teacher's skill in teaching science and fostering creativity development.

3. Data Analysis

Korean students' responses to the interview questions are organized question by question. They were also color-coded and reorganized under each research question, where appropriate, and analyzed. The interview questions and responses that were not directly related to research question were organized separately. The content analysis was used for conversing qualitative data and identifying patterns and themes in the interview data. After identifying patterns and themes, the researchers developed category systems. The researchers also carefully examined deviate cases or data that don't fit the categories developed. Each of two researchers developed the coding scheme independently, then compare and discuss similarities and differences.

IV. RESULTS

1. How do Korean Gifted Students Learn Science in GERI Program?

In terms of class organization, Korean students reported that GERI science class in general consisted of large portion of discussions and activities, individual research, and lecture while it varied from class to class. For instance, whereas individual research through internet and literature search was of focus in medical microbiology class, biochemistry students had more lectures and discussions. Three students reported that group discussions followed by every experimental and individual activities in science courses.

Five of six participating students reported that they enjoyed GERI program since it provided a fun, creative, and new way to learn science even though they were already familiar with the content of most science classes. In fact, some student felt relaxed and comfortable because the content of the class was not difficult to understand. They also did not feel burdened due to no pressure on grades in GERI program and its nature as a field trip. In particular, students reported that many students enjoyed participating in Forensic science class since the subject is new to them and the class was filled with a variety of opportunities with hands-on experiments based on great teacher preparation.

I don't feel burdened, because everything does not go into your grade like school...there is nothing like I have to study. I think it is very relaxed (ID #5).

We thought the lesson was too easy, so we were able to listen to the class comfortably even though we can't speak English well (ID #1).

Forensic science is fun. We are doing experiments on materials we have not learned before so it's fun (ID #6).

The other hand, many students sometimes experienced various degree of frustration with GERI program when they perceived the class as too easy with slow pace. They also commented that the class was not systematically organized, which led to confusion in understanding the content and prevented from having clear expectation for the class.

I liked biochemistry but the contents seemed a little too easy (ID #2).

Teacher throws out a topic and we exchange our opinions but we don't come to a conclusion and we move on. Since we don't come to a conclusion, there are times when the Korean students are frustrated (ID #6).

The biggest challenge the students encountered was language barrier in understanding the lecture and communicating with a teacher and other non-Korean students. All Korean students expressed strong feelings of frustration about their limited English proficiency although they felt the content of class was not challenging. In Korean high school they attended some science courses that required reading textbooks written in English. However, since many professional terminologies were unfamiliar to them, the students could not understand some part of the lecture, which frustrated

them. In fact, in the middle of class, some Korean students were observed to keep looking up an electronic dictionary and have hard time catching up with the lecture. There was quite a variation in the amount of interaction between a teacher and Korean students depending on class (e.g., Korean students in Biochemistry class were observed to respond to and interact more actively with the teacher than those in Forensic Science class), the language problem was identified as a biggest barrier for active involvement in class discussion.

During discussion, Korean students have a lot of thoughts and if we were in Korea we could say a lot of them. I understand the content, so now that we have thought we need to report on it, but already they staying the next thing (ID #5).

Even if we know…still we cannot speak English. We are not students who can speak English that well. So there are kids who are really good at English and there are students who just speak a certain acceptable level…but interpreting biology vocabulary is hard, you know? If we interpret that using a dictionary, in that time, the question just gets away (ID #6).

2. How is Their Creativity Developed?

Most of Korean students agreed on the critical role of teachers played for students' creativity development. They reported that some particular teachers' teaching strategies and guidance were important to foster students' creativity. In particular, they identified creative questioning, openness and flexibility, minimal but careful guidance, deep knowledge delivery, encouragement for independent inquiry and discussion with peers as effective teaching strategies to help them develop scientific creativity. For instance, some students believed that they could improve their creativity through making their own procedure and solution with a teacher's careful guidance. One student highlighted, however, that a creative teaching style was not always good because it might generate more confusion in students' thinking and understanding.

Even if you know the question, when you receive the question, you get an opportunity to think differently one more time (ID #5).

If a teacher has no creativity, the class can only be conducted in one direction. If that is the only way students can receive information, student's creativity can really deteriorate due to the fixed notion of how the students receive information (ID #2).

If the teacher is too creative, it is shaking the students' basic concepts and they can get left in confusion (ID #6).

Many students reported that they preferred self-lead independent study method and believed that it helps them to study science and develop scientific creativity. In particular, they responded that independent book reading was a good way to develop creativity as well as acquire existing knowledge with the assumption that no creative ideas came out of vacuum.

I usually study on my own. Doing it alone is well…I used to like biology when I was younger. In the bookstore, I would just choose any book and I wouldn't go to the study institution for a month and just take any biology book and study it (ID #3).

I think reading book is the best way to develop creativity. You have to learn the basics. When you read books you get points of inquiry, so you just get to do research on your own. You get to just ask questions on the spot (ID #5).

Other students favored peer discussion as an effective strategy for scientific creativity development, but only under certain circumstance. They benefited from peer discussion to develop creativity by exchanging information, expending their perspectives, exposing themselves to new opinions, and making themselves more flexible and open.

You can plant creativity through discussions especially when they gathers only the kids who know about this knowledge well. For example, if we just get the kids who really know about Math, we can think like this and that, in many different ways (ID #6)).

In group projects, you listen to different thoughts, so someone else thinks of something that I had not thought of at all. So after I listen to that my view, my perspective gets widened. So in the process of sharing

information, perspectives get broadened and information is gathered. So, I think it helps with your creativity development having to come up with new things (ID #2).

3. What Aspects of the GERI Science Class Experience do Korean Students Perceive as similar to Their Home-school Science Experience and What Aspects are Perceived as Different?

Overall, Korean students reported that many aspects of GERI program for gifted students seems to be similar to those in Korean gifted high school in terms of teaching style, feedback, creativity of teachers, and classroom climate. Most of students agreed that both programs made substantial amount of efforts to develop students' creativity.

They're similar…because we listen to classes that a lot of Koreans take, it's like a Korea (ID #5).

There doesn't seem to be much difference. There are times when we take one thing and discuss it too in Korea. So, I think class climate is similar (ID #6).

Creativity becomes an important criterion during evaluation. They're trying not to destroy creativity too much while educating students, so it's becoming more open. The aim of our school is also to develop students' creativity. Of course, we put in a lot of effort to make someone who will make a point in science for Korean future and also to heighten creativity. But the program's goal here is to build creativity as well, right? So I think the two schools are really making an effort for the students (ID #1).

There exist differences between two programs as well. Many students mentioned that both programs are good but in different ways. For example, most of students agreed that participation in GERI program would be more beneficial in creativity development because of its educational approach that placed a high emphasis on creativity and the more varieties in content. They also reported that there were more varieties of content and topics in GERI program than Korean high school. On the other hand, they mentioned that Korean teacher' teaching strategies were more effective in learning theories in depth and acquiring the substantial amount of knowledge base.

Here, in GERI, they convey some more colorful and varied things. Things that are different from what we know. Like, messenger RNA is what percent? It's not very important stuff, but they explain it very well. In Korea, because we use theory as the basis, we can go more deeply (ID #4).

GERI teachers are more creative in general. Korean teachers teach in more systematic ways. Both teachers put lot of effort to help students develop creativity. Our Korean teachers are confined to the text in the book, so I think the scope of their teaching is narrower but there's nothing you can do about that. Here, depending on what the teacher wants, he/she can try to teach this or try to teach that, you know? (ID #1).

I think there's more variety in the course content here (ID #1).

When looking at creativity alone, I think GERI is better. You can do things more freely here (ID #5).

For other differences, students pointed out there are more discussion in GERI program than Korean high school while Korean high school focuses more on presentations. However, some students reported that because of language, they felt more comfortable and active to participate in discussion in Korean high school. In addition, as many students mentioned, GERI classroom provided more free and progressive atmosphere than Korean high school.

Our school is mostly presentations and here it is mostly discussions…so the teacher throws out a topic and we exchange our opinions (ID #6).

I don't think that (discussion) happens very actively (in GERI program). Since it's a class with a lot of Korean students, we can't speak in English well and so…(ID #5).

Well, it is very free, you're free to sit anywhere. The thing I am most surprised about is the attitude, you grow up freely here, like you listen to class with your class up on the desk. (Laugh) I was taken aback at first. But the teacher is not concerned

with it too much and if you're comfortable listening like that they think it's fine (ID #2).

Some students pointed out they have experiment sessions separate from lecture in Korea whereas class sessions were immediately followed by labs in GERI program. For some subjects, a teacher teaching in class is different from a lab teacher. Although the class and lab teachers sometimes get together and match the content of class and lab, some students sometimes felt that the content of experiments was not well connected to what they learned in class in Korean high school. In addition, the more advanced materials and experimental tools and more updated resources available in GERI program than Korean high school even though the differences in the quality and quantity of the resources between two programs were not large.

There are separate times. The things you talk about in class…the theory just stops. So then, it moves over to lab or there is a separate lab. Here, you have class and it moves over to lab immediately or you just think of a lab. In biology, there is a different teacher. So if in class we're talking photosynthesis, the lab would be dissecting, it can go something like this. The connection cannot be made (ID #3).

There are also many different books…it's a college here so there's a lot…experiment supplies too. They say our school is good, but everyone has to be the same small telescope together. Students use it many times, so it's a bit old. If it's dirty or not maintained well, there are times like that, but I think GERI has a bit better machines (ID #3).

V. DISCUSSION

The purpose of the present study is to examine the effectiveness of the summer enrichment program implemented in Purdue Gifted Education Resource Institute (GERI) by interviewing Korean Gifted students who joined the program in 2005. From the results, we can infer what steps to be taken to improve not only the quality of the Korean gifted education programming and the educational administration but also the quality of Purdue GERI summer camp.

According to the results, the followings are discussed;

1. Korean students enjoyed most of the camp programs in spite of their difficulties in English. Most of students reported GERI program was fun, creative, easy, relaxing, and less demanding than Korean gifted education program. They were grateful to be provided opportunities to meet their diverse interests in the world of new science in GERI gifted camps. However, four students reported that they were frustrated with the program which was too easy and went through in slow pace. They commented that the lesson plan and lesson delivery was not organized systematically. This reflects that Korean gifted high school students has developed domain-specific performances especially in science and pursue high level of academic excellence in these domains. Even though the Korean students expected GERI program to be stimulating at higher level and organized more systematically, overall they found GERI program experiences satisfying for their psychological and academic needs. These findings are congruent with Enerson's study (1993).

2. GERI program focusing on group discussion stimulate creative thinking and independent research skills. GERI teachers began with group discussion along with a brief explanation of concepts. The group discussion was well connected with laboratory class and hands-on activities. During discussion, GERI teachers' minimal but effective and open guidance was helpful for students to solve the problem more creatively. This suggests that GERI program developed from Purdue 3 stage enrichment model foster creative thinking skills in the 1st stage. This is consistent with Davis's (2004) findings that show hands-on activities and projects, including individual and small group projects, are useful strategies to develop students' creativity. Peer collaboration, in particular, was found to be very useful because it may create a supportive learning environment that assists the students with solving the challenging academic tasks and fosters the development of creativity and confidence as Diezmann and Watters

(2001) suggested.

3. Even though there were various differences between GERI program and Korean gifted education program in the class organization, focus, teaching strategies and overall quality of the class, most students mentioned that both programs are good but in different ways. Much more emphasis on creativity, more variety in gifted course content, and more fun and relaxing environment were strengths of the GERI programs.

As a conclusion, students' experiences with GERI programs were mostly positive and satisfying. Most students reported that they would like to participate in GERI Camp again someday. This also proves the positive effect of the GERI programs on their science learning and life.

Gifted programs should contain and include systematic and high level of content in subject area or talent domains. GERI camps have strength helping gifted students to find friends who share their interests and who love to learn. GERI programs could be more successful when ensuring students to experience academic challenge, make good friends, and get self-understanding simultaneously.

From the model of GERI, followings are recommended to improve gifted education implementation:

1. We need much more diverse courses to meet gifted children's various needs using advanced teaching materials and equipments and class size should be kept small so that teachers have more opportunities to interact with each student and to meet the student's individual needs.

2. The topics and contents of gifted science classes and lab sessions should be well connected to maximize the gifted student's learning and creativity.

3. Special afternoon and gifted camps should focus on creativity, critical thinking, and independent learning rather than academic excellence.

4. Gifted education learning environment should be academically stimulating but should not be stressful since the high level of stress would undermine students' motivation and eagerness to learn rather than foster their creative thinking.

5. Gifted programs should allow students to share their common interests with other high-ability children, and give opportunities for students to wrap up what students learned from school into a big integration.

6. Each school needs to cooperate with universities to make successful gifted education implementation to access various resources including facilities and faculties available in large university environment.

VI. SUMMARY

The purpose of this study is to examine the effectiveness of the summer enrichment programs on Korean gifted students' science learning and creativity development. This program is organized by Purdue University Gifted Education Resource Institute (GERI) in U.S.A. Researchers conducted semi-structured interview with 6 Korean students and observed 12 Korean students and GERI teachers for teacher-student interaction and teaching strategies during science- related classes. From the results, GERI program developed from Purdue 3 stage enrichment model that emphasizes creative teaching strategies, group discussions, and individual research were effective to foster creative thinking of Korean gifted students. Despite their language barriers, Korean gifted students found GERI program experience fun, creative, easy, relaxing, and thereby satisfying for their psychological and academic needs. They expected the level of stimulation in GERI program to be higher and the class to be organized more systematically; however, they reported that the broad range of topics and diverse content of GERI classes helped them develop creativity more than Korean classes. These findings will make contribution to the improvement of the quality of gifted education curriculum and programming in Korea.

REFERENCES

Avery, L. & VanTassel-Baska, J. (1997). Making evaluation work: One school district's experience. *Gifted Child Quarterly, 41*, 124-132.

Davis, G. A. (2004). Objectives and activities for teaching creative thinking. D. J. Treffinger, (Ed). *Creativity and giftedness.* (pp. 97-103). Thousand Oaks, CA: Corwin Press.

Diezmann, C. M. & Watters, J. J. (2001). The collaboration of mathematically gifted students on challenging tasks. *Journal for the Education of the Gifted, 25,* 7-31.

Enerson, D. (1993). Summer residential programs: Academics and beyond. *Gifted Child Quarterly, 37,* 169-176.

Hus, L. (2003). Measuring the effectiveness of summer intensive physics courses for gifted students: A pilot study and agenda for research. *Gifted Child Quarterly, 47,* 212-218.

Lee, S. (2002). The effects of peers on the academic and creative talent development of a gifted adolescent male. *The Journal of Secondary Gifted Education, 14,* 19-29.

Kolloff, P. B. (1991). Special residential high schools. In N. Colangelo & G. A. Davis (Eds.), *Handbook for gifted education* (pp.209-215). Boston: Allyn and Bacon.

Korean Educational Development Institute (2003). *Current status of teaching and learning at educational institutions for the gifted.* Seoul, Korea: Author.

Moon, S., Feldhusen, J. F. & Dillon, D. R. (1994). Long-term effects of an enrichment program based on the Purdue Three-Stage Model. *Gifted Child Quarterly, 38,* 38-48.

Park, K. (2004, July 4). Gifted education in Korea (chap. 6), Retrieved December 2, 2005, from http://www.math-love.com/new3/notice/data/Chap6(kPark).doc.

Park, S., Park, K. & Choe, H. (2005). The relationships between thinking styles and scientific giftedness in Korea. *The Journal of Secondary Gifted Education, 16,* 87-97.

Patton, M. Q. (2002). *Qualitative research and evaluation methods.* Thousand Oaks, CA: Sage.

Pyryt, M. C., Masharov, Y. P. & Feng, C. (1993). Programs and strategies for nurturing talents/gifts in science and technology. In K. A. Heller, F. J. Monks, & A. H. Passow (Eds.), *International handbook of research and development of giftedness and talent.* NY: Pergamom Press.

Seo, H., Lee, E. & Kim, K. (2005). Korean science teachers' understanding of creativity in gifted education. *The Journal of Secondary Gifted Education, 16,* 98-105.

Tyler-Wood, T., Mortenson, M., Outney, D. & Cass, M. A. (2000). An effective mathematics and science curriculum option for secondary gifted students. *Roeper Review, 22,* 266-269.

Appendix 1. Interview Protocol

1. Please describe to me how you learn science in your Korean high school?
   a. Teacher lecture, quite reading, teacher asking questions, class discussion.
   b. Do you have any projects? Please describe your favorite one. How presented?

2. Please describe to me how you are learning science in your GERI science class?
   a. Teacher lecture, quite reading, teacher asking questions, class discussion.
   b. Do you have any projects? Please describe your favorite one. How presented?

3. Who do you think is more creative, our Korean science teacher or your GERI science teacher, and why?
   a. How does their creativity affect their teaching?

4. Which science class, your Korean science class or your GERI science class, is more fun to learn in and why?
   a. Classroom atmosphere, willingness to ask questions, teacher encouragement, class/group discussion.

5. Which science class learning environment, your Korean science class or your GERI science class, has helped you develop your scientific creativity more and why?

6. There are many ways to learn science such as; reading textbooks, individual projects, group projects, class discussion, teacher lecture, fieldtrips, and teacher guided individual research. What is the best way for you, personally, to learn science and why?