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A Mentorship Model based on KIGES' Mentorship program

Hyunsook Sunk, SangChun Lee, JungYun Heo, JeongSoo Woo.

Mentorship as an enrichment program as well as a promising educational method in the 21st century for the gifted students in science provides young scientists with opportunities to develop their abilities and attitudes regarding research. Kyungnam Institute of Gifted Education in Science (KIGES) has run mentorship program for five years. Many advantages of mentorship program for the science gifted students are reviewed including those of KIGES. A mentorship model for future student research programs is proposed as a way to facilitate the process of mentorship.

Key words: Mentorship model, enrichment program, constructivism

I. Introduction

A half century ago, Passow (1958) mentioned about the difficulty in planning an educational program for gifted students. According to Passow, "There is no simple formula for appropriate education for gifted students" (p.193). It is not easy to develop a program for them since we should take into account two things in the program development, such as the characteristics of gifted students including their needs and problems as well as the needs of society for people with high-level abilities. The same

concern is still persistent in the area of education for gifted students.

Among the educational methods elaborated for gifted education, enrichment program along with acceleration has been found to be effective for gifted students. According to Renzulli and Reis (1994), enrichment programs are the educational approach most commonly used in gifted education. Enrichment programs appear to satisfy personal needs and high-level capabilities of gifted students, enlarging their knowledge base as well as leading to development of creativity and other thinking skills.

Activities included in enrichment program are helpful to achieve higher-order objectives, encompassing such diverse areas as maximizing the basic skills of the learners' needs, content and material beyond ordinary curriculum, a number of learning opportunities, content selection by the learner, creative thinking skills and problem solving. In addition to the contribution to cognitive development, affective and career-related objectives for gifted students can be reached, including self-understanding and moral development, motivation and career development (Davis & Rimm, 2004). Schack (1986) also found that enrichment program helps students increase their self-efficacy which enables them to carry out a problem successfully in the future.

Mentorship as one of enrichment programs has been applied to gifted students in science and engineering worldwide in terms of meeting the special needs of gifted students (Korcsmaros & Csermely, 2003; Torrance, 1984; Hong & Kim, 2000). As a specific enrichment program, mentorship appears to be an effective instrument to achieve those objectives of enrichment program with regard to its process and content. According to Renzulli and Reis (1994), mentorship is an appropriate program for students with higher levels of ability and task commitment as it emphasizes investigative activities necessary for being a first-hand inquirer.

Mentorship program for gifted students is also supported by learning theories, such as Vygotsky's constructivism, situated learning, and cognitive apprenticeships (Schunk, 1996). When we consider an ongoing and caring relationship between an adult expert and a novice student in mentorship, the ideas of constructivism can

be realized in the process of mentorship.

In this paper, mentorship program in KIGES was introduced as one educational method appropriate for gifted students in science. Some benefits of mentorship program for KIGES students were also introduced. Based on KIGES' 5-year experience in mentorship program, a mentorship model was proposed that might facilitate the process of mentorship between mentor and mentee.

II. Theoretical Background

1. What is Mentorship?

Historically, the origins of the term 'mentor' trace back to Greek mythology. In Homer's *Odyssey*, Odysseus who was to leave his son behind to fight in the Trojan War entrusts his friend, Mentor, to guide and help overall development of his son, Telemachus. Mentor was regarded as a wise adviser, playing a role model for young Telemachus (Cox & Danial, 1983; Miller, 2002).

In this way a more experienced adult, mentor, is expected to provide support, advice and challenge to a younger person, mentee. Mentorship is a relationship between mentor and mentee. The classic mentorship model was that of the expert and the apprentice in craft enterprises. A more recent model is that of the mentor and mentee in business settings as well as in school systems (Miller, 2002).

Anderson and Shannon (1995) suggested the characteristics of mentoring based on the review of the origins of mentoring. Mentoring is intentional and a nurturing process to help people become their full potential. In addition, mentoring is an insightful process that helps the mentee acquire wisdom. The relationship between mentor and mentee is caring and supportive. In this relationship, mentor plays a role model, that is one of multiple roles assumed by mentor, including teacher, expert, guide, advisor, friend, and role model (Clasen & Clasen, 1997).

With regard to these characteristics of mentoring, Zorman (1993) distinguishes mentoring from other relationships in the following perspectives: First, there is

common passion between mentor and mentee for a specific area of interest. Second, teaching and learning styles are compatible between them. Third, their friendship can last for long time. Fourth, their relationship moves toward equality as the mentee acquires knowledge and skill from the mentor. Lastly, mentee gradually adopts patterns of mentor, exhibiting changes in attitudes and lifestyles.

Given these characteristics, main objectives of student mentoring can be classified into three categories, such as developmental, work-related, and subject objective. The developmental aim emphasizes the personal and social development of the student. This objective can be accomplished through the relationship between mentor and mentee. The work-related mentoring focuses on helping students set up goals with regard to the career choice and knowledge of the world of work, and acquiring job-related skills. Lastly, the subject mentoring concerns about both students' achievements in their school work and improving study skills.

In the course of mentorship, attitudes and values of the mentee can be changed and shaped. This signifies that mentorship does not exclusively focus on developing the knowledge and skills of the mentee (Miller, 2002). The primary goal of mentorship lies on personal and professional development of the mentee.

To be successful in a mentorship, congruences between mentor and mentee are important with regard to gender, social class, ethnicity, experiential background, values, and attitudes. The more congruent between mentor and mentee in these aspects, the more likely the mentee will regard the status and lifestyle of the mentor's profession attractive (Arnold & Subotnick, 1995; Daloz, 1999; Lauland, 1998).

Mentorship is also helpful for the participants to become mature in social and emotional development. Shaughnessy and Neely (1991) found that mentorship was helpful for the young participants to reach their potential with the assistance of mentors who guide them through difficult times in their personal times. According to Heath and McLaughlin (1993), to be involved in the research activity beyond school provides students to build a sense of self-efficacy and success in different events.

Besides, characteristics of a mentor are also important for the successful

mentorship. First of all, the open-minded and nonjudgemental attitude of a mentor facilitates the relationship between mentor and mentee. Social and emotional support by a caring adult was helpful for the students to build confidence in themselves (Hebert & Olenchak, 2000). Kaufman et al. (1986) also found that gifted young people valued the role model, support, encouragement provided by the mentor far more than the professional interaction. Furthermore, interest-based intervention for the underachieving gifted young persons was successful. In conclusion, mentor should be someone who can help mentee with his or her intellectual, psychosocial, and career development in the area where he or she pursues (Clasen & Clasen, 1997).

Characteristics of mentee are also important for the success of mentorship. Mentee should show readiness, such as demonstrating exceptional ability, perseverance, enthusiasm for the area to study, and commitment to time and study (Atkinson, Hansen, & Passman, 1992). In addition, they should be fully motivated to pursue unknown area as independent learners (Reilly, 1992).

Once the compatible realtionship between mentor and mentee is established, even short period of relationship between them can be influential to mentee. Seven-week participation in a research program was found to be effective for the participants to understand the culture and practice of science. Participants, in particular, were able to access the culture of science by being familiar with technical language used in the laboratory-centered community of scientists as well as collaborating with scientists and peers for the research (Richmond & Kurth, 1999; Lim, 2004).

Clasen and Clasen (1997) summarized benefits of mentorships in the seven perspectives as follows: First, mentorships can meet the needs of the students with exceptional ability. Second, mentorships can help students explore and develop career, allowing them to question their abilities and interest. Third, the relationship between mentor and mentee can be helpful for mentee to develop potential as the mentorship relationship provides the unique environment that facilitates change in attitude and achievement. Fourth, mentorship can help

psychosocial development of mentees since mentees are encouraged to be self-reliant and self-directed in the ways of learning and interacting with others during the mentorship. Fifth, mentees can get a sense that they are connected to the larger world as they see their interest as part of a world and their work a contribution to the field of their interests or specialty. Sixth, mentorship is beneficial to both mentor and mentee. Mentor can be rewarded as he or she completes a project being stimulated with new ideas while carrying out the project. Mentor will be satisfactory with the idea of serving for the next generation which is one of the tasks of mid-age men. Lastly, mentorship relationship will help mentee be linked to community and schools as the relationship between mentor and mentee helps mentee explore resources available in the community and schools.

Among the mentoring schemes, one-to-one mentoring model is the most commonly used in the mentorships. Small-group mentoring, however, has been widely applied by gifted education institutes. It has some advantages and disadvantages. Students in small-group mentorship are less embarrassing to meet a mentor with other students. They learn to work as a group and listen to each other. Students indicated that small-group mentorship is a way of developing social relationship among participants. Some disadvantages, however, might be lack of time for the mentor to work with each student, and the lack of privacy discussing personal issues in the group with the mentor (Miller, 2002).

2. Social Constructivism

The way to implement mentoring precludes the instructional method that focuses on transmitting knowledge to the learners by the teacher. Advocates of mentoring can find most support in the social constructivism of Vygotsky (1978) for the role of mentoring in promoting young people's learning. He stressed the importance of culture and social context in learning or cognitive development. A key concept is the 'zone of proximal development' (ZPD), which suggests that young people with the help of more advanced peers or adults can understand ideas they would not

be able to figure out by themselves.

Some of the key principles of constructivism include the ideas as follows: Learning occurs as a result of a social collaborative activity; learning develops in the real world and in meaningful contexts (Schunk, 1996).

In addition, situated learning indicates that to be useful knowledge must be situated in a real or authentic context. According to Brown, Collins and Duguid (1989), knowledge is a product of the situation, culture, context in which it is used. Cognitive apprenticeship is one way to demonstrate situated learning in which the role of coach or mentor provides cognitive scaffolding. 'Scaffolding' is a term used in the field of construction and it is a kind of plank that helps construction worker carry heavy load to high building. Applied to a learning situation, scaffolding is support or help provided by the mentor for learners to make sense of the learning task by relating it to personal experiences (Bruning et al., 1995). The support provided by the mentor can gradually be reduced as mentees begin to control task elements and construct their own knowledge and understanding. Mentors usually provide authentic, experiential learning environments as well as an interpersonal relationship through which social learning takes place (Kerka, 1998). In situated learning, collaborative problem solving is emphasized as a strategy.

When we consider situated learning as a way to provide learning environments, planned mentorships share the common features of situated learning (Evans & Hoffmann, 2000). They include the following aspects: First, mentees are encouraged to experiment in research project; Second, mentors and mentees discuss authentic contexts for learning and development; Third, mentors pass on their own expertise and experience to the mentee; Fourth, knowledge is constructed through the collaborative work between mentor and mentee; Lastly, mentoring provides scaffolding to help mentees' learning.

During the course of situated learning, mentees or apprentices move from legitimate peripheral participation (Lave & Wenger, 1991) in the community of profession to a central role over time as they learn and build expertise through

observation and noting important values in their community of practice. In other words, mentees or novice learners gradually move from the periphery to the center of their community's activities. Some aspects of mentorship help young mentees become involved in communities of practice at the local university or college, and in local community organizations. In this way they can be engaged in more personally and socially meaningful learning (Greeno, 1989).

III. Mentorship Program in KIGES

1. Purpose

Mentorship program in KIGES has been provided for those students who have finished a one-year middle school program in KIGES. In the course of studying one-year middle school program, students can solidify their basic knowledge on their interest area through the participation in cyber education, weekend program as well as an intensive program during the vacations. Since the inception of KIGES program, there have been increasing demands by the students for having opportunities to research or experiment as a scientist-to-be.

In addition, there emerged an educational necessity by the students for enhancing their capability of carrying out a real research project. In order to meet the needs of the students, one-to-one tutorial activity, that is, mentorship was devised to enrich the students' learning experience with the help of professors and researchers. Working closely with the university professors or researchers in a laboratory provides an authentic learning environment for the students. In this program, students are able to experience a real world of profession. They are expected to maximize their creativity and science inquiry capability by participating in a program voluntarily as well as by enhancing their independent study skills.

2. Who are eligible for mentorship program?

Those students who are in the second year of the middle school program in KIGES can apply for the mentorship program. In addition, students who are in the 9th grade can apply for the program although they are in the first year in KIGES. When it comes to eligibility of the students, KIGES selection process appears to demonstrate that students at KIGES are prepared to implement a research project with experts.

KIGES selects students by employing a multiple identification procedures, including three phases. In the first phase, applicants are required to submit several documents, such as a recommendation letter from their principal, teacher, or director of gifted education institutes, honors, academic records, personal statement focusing on interests area, and any kind of products including portfolio and papers that can be an evidence of the applicant's creativity and giftedness. After being screened based on the submitted documents and products, students in the second phase take a written test that measures applicants' creativity and problem-solving capability. In the second phase, twice as many as the students to be finally selected are screened to enter the third phase. In the final third phase, applicants are required to present after resolving a given task. In this phase, they are expected to show actual performance in the area they applied for. Applicants also have an interview with empires who ask questions to explore their giftedness. As the KIGES students go through such a thorough selection process, it is assumed that they are eligible for participating in mentorship program when they finish one-year program of middle school level in KIGES.

Not all the students who complete one-year middle school program apply for mentorship. We can assume that those who apply for mentorship program are interested in and motivated for further research. They are believed to show a commitment to their interest area and open to advice and feedback since they apply for the program voluntarily. In this respect, those who apply for mentorship program are eligible.

3. KIGES 5-year experience in Mentorship programs

The KIGES mentorship program was initiated in the year 1999. This program has provided opportunities for the participants to experience real-world research and contribute to science and technology. In this section, mentorship program changes and benefits are introduced.

In the first year, 3 research topics in the areas of mathematics, physics, and chemistry were offered to the students, such as nature of dilogarithm, glow discharger and vacuum system, and development of copper vapor laser using glow discharger. Students who were willing to join mentorship program had a choice to select one preference among the three topics. There was, however, a limitation of accepting students less than 3 in each project.

When the applicants exceed the limited number of acceptable participants, they are selected based on the selection guidelines of KIGES. In this case, final decision was made in accordance with both the results of Summative Assessment of Scientific Giftedness developed by KIGES to measure student's achievements and attitude in the class throughout the year, and performance assessment by the KIGES academic advisor.

Once selected, students work closely with a mentor who is academic advisor or professor in the university. Taking into account the characteristics of mentorship, both mentor and mentees as a group plan and implement the research project voluntarily. In other words, they decide on content, instructional methodology, frequency of meetings, meeting time and place, and so on.

Although formal guidelines for implementing mentorship program are not provided, mentor and mentees usually decide on the overall plan and schedules on their first meeting in accordance with mentorship objectives. Activities for both mentor and mentees are also discussed. During the time of carrying out research project, mentor, at first, provides some guidelines to help mentees carry out research project. For this purpose, mentor gives a lecture or seminars on the research topic. Gradually, mentor reduces help and gives mentees more autonomy to implement research project. Around the end of mentorship program, mentees are

expected to take the role of a first-hand inquirer. In this way, scaffolding has been applied to mentorship program.

In the first year, 1999, in KIGES mentorship program started from September 1st and continued to January, 2000. For 5 months students worked with the mentor in the laboratory doing experiments. After completing the research project, mentorship participants were required to present as well as display their research results on the graduation day. All the KIGES students, instructors and parents were invited to the presentation and there were usually very active interactions going on between the audience raising questions and the presenters defending themselves.

Some changes in mentorship program have occurred. First of all, 5 students, not less than 3, have been allowed for each program from the third year. Second, informatics and advanced science were added to the program. Third, mentorship period has been extended from 5 months to 9 months from the third year. Fourth, biology has been added to the program from the fourth year. Thus, mentorship has become to cover all the areas offered to the students in middle school program by KIGES. Lastly, mentorship program has become an all-year-round activity from the fifth year covering the whole academic year and the number of participants for each program has increased up to 10 students.

Program titles and the number of participants are summarized in the table <III-1>.

<Table III-1> Number of mentorship projects and participants for 5 years in KIGES

Classification	Number of Projects	Number of Participants	Presentation	Reference
Year 1999	3	9	Presentation and Poster Display	
Year 2000	5	15	Presentation and Poster Display	
Year 2001	6	26	Presentation and Poster Display	
Year 2002	8	31	Presentation and Poster Display	
Year 2003	7	41	Presentation, poster display and publication	Published in *Journal of Mentorship and Creativity* (JMC)
Year 2004	13	63	Presentation, poster display and publication	To be published in JMC

Survey on the mentorship program participants showed what they benefitted from the program as well as several things to be desired in the program. According to Heo, Lee, and Choi (2003), KIGES mentorship participants are highly motivated in joining the program. Around 65 per cent of the respondents (N=23) indicated that they participated in the mentorship program to acquire advanced knowledge and to have extraordinary experience in doing experiments.

According to the recent research (Lim, 2004), high school students in the United States indicated that more than half of them participated in the 7-week mentorship program to do research with professional scientists. In addition, to learn how to do scientific research was found to be important for them followed by the exploration of career. This finding shows that they are interested in further exploring and pursuing their research interests rather than expanding knowledge or improving academic performance. In other words, most of mentorship participants are motivated internally rather than externally.

Benefits from the mentorship participation include diverse aspects of situated learning, such as confidence in carrying out a difficult task, development of critical thinking and presentation capability through discussions, real experience in working with scientists, interest in new areas, importance of collaboration among group members in doing experiments, achievement of carrying out a difficult experiment without guidelines, and identification of one's own aptitude (Lim, 2004; Heo, Lee, & Choi, 2003; Moon, 2004).

Besides, mentorship program was found to be helpful for participants in terms of achieving higher-order thinking skills, such as critical and creative thinking, and problem-solving capability. They indicated that creativity appears to increase after resolving the problems with a lot of curiosity and inquiry. This process also helped them enhance problem-solving capability, giving them a sense of achievement. This finding corresponds to what they expect from a mentorship program. In other words, more than half of the respondents thought that mentorship should focus on helping students build creativity and logical thinking capability.

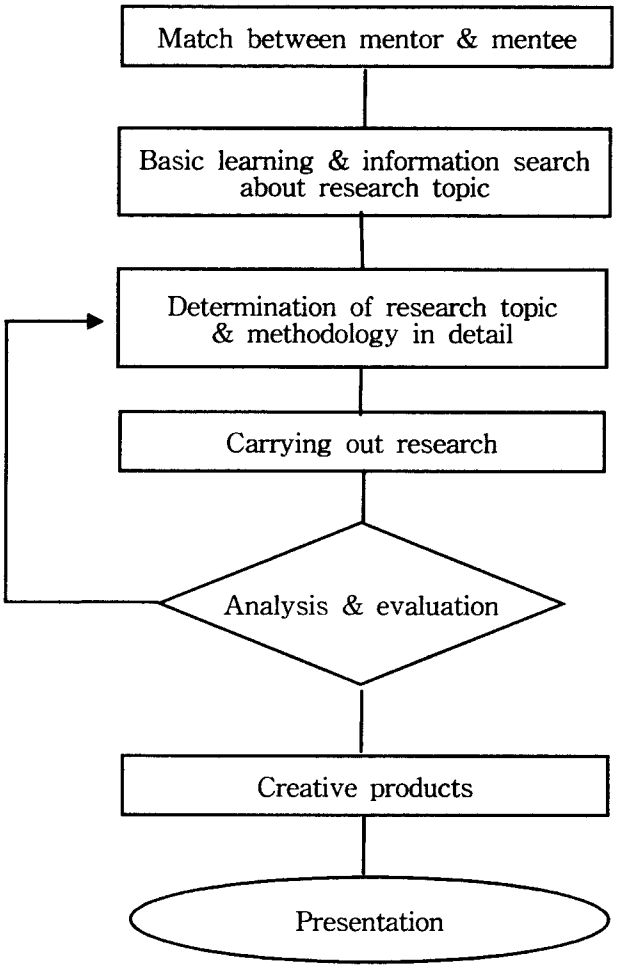
US students also found mentorship program to be helpful for grasping the nature of a real research. They were also able to get more scientific knowledge in depth. In addition, they could learn such things as the guidelines of career selection, responsibility and self-control, communication skills, advanced research area, and so on (Lim, 2004). These results show that mentorship program can provide students with benefits that can be hardly available in school learning.

As Moon (2004) found, enrichment program such as mentorship that emphasizes students' exploration of their interests can help participants build their personal talent. Benefits of joining a long-term project include increase in both intrinsic motivation and resilience to persist being faced with obstacles, and development of self-regulation skills.

IV. A Mentorship Model

Based on mentorship results including KIGES mentorship experiences, a mentorship model is proposed. The ideas of constructivism were applied, such as scaffolding and situated learning, to building this model.

Mentorship goes through such stages as building a relationship between mentor and mentee based on their compatibility in terms of gender, research area, commitment, and so on, determination of general research topic, learning of basic knowledge and information searching, determination of research topic as well as research methodology in detail, implementation of inquiry, analysis and evaluation of research, and presentation of creative products. These stages include instruction and learning processes.



[Figure IV-1] A Mentorship Model by Stages

Setting up the stages as the above is to facilitate the successful implementation of mentorship project. As Clasen and Clasen (1997) indicate, mentorships without pre-planned processes such as the assumed role of mentor and mentee, systematic feedback, and the compatibility between them can lead to failure. Ten-step processes with three phases have been suggested for the effective implementation of mentorship program (Clasen & Clasen, 1997). In the first phase, 5 steps to prepare for the mentorship program should be taken, including assessment of

mentorship as the best educational option for the gifted student, recruitment of mentors, selection of potential mentors, match between mentor and mentee, and provision of mentorship orientations for all participants.

In [Figure IV-1], the first and second stages are equivalent to the first phase of preparation by Clasen and Clasen (1997). In these stages, match between and mentee should be considered, taking into account gender, interests, and instructional and learning styles. In other words, compatibility between mentor and mentee should be considered. Mentor and mentees from the beginning work together for the mentorship program. Mentor, however, plays a primary role in guiding mentee with regard to giving ideas of research topic as well as providing instruction about how to search relevant information and materials. Through the first two stages, students are expected to acquire basic knowledge regarding research topic and they are ready to carry out mentorship project.

In the second phase including the stages of determination of research topic and methodology in detail and carrying out research in [Figure IV-1], mentor helps mentee actively participate in the mentorship project, asking him or her to keep a journal of thoughts, activities, and learning experiences. As the mentorship program goes on, mentees gradually take over the primary role in determining specific research area and methodology. With the minimal help of mentor, mentees carry out research project by collaborating with group members through discussion and experiments. Mentors provide systematic feedback to mentees, which facilitates the mentorship to take its course.

The stages of analysis and evaluation, creative products, and presentation are corresponding to the final phase of Clasen and Clasen (1997). Mentees take a major part in analyzing and evaluating what they have done. If the results of mentorship are not satisfactory, mentees go back to the prior stage to review their methodology and approaches to carrying out research. They implement research project one more time. If and when they are satisfied with the results that meet mentorship goals or research hypotheses, they can move to the next stage to demonstrate what they have accomplished, that is, creative products. In the

process of analysis and evaluation, mentees are able to reflect their ideas and thoughts, which results in the development of higher order thinking skills as well as enabling them to become autonomous learners.

Evaluation of mentorship can be done by both mentor and mentee. Evaluation on the part of mentor includes case studies, questionnaires, and self-reports on the process and effectiveness of the mentorship. After being satisfied with mentorship results on the part of mentees, they move to the next stage of creative products. Creative products may include a research paper, poster or exhibition, and artistic works. Finally, they present what they have found or final products to other students and are open to advice and feedback from them for further research.

In this model, students are able to construct knowledge in a real world. In other words, authentic and situated learning occur to them as they interact with adult experts and other gifted students in the laboratory. Thus, participants in this type of mentorship are expected to widen the 'zone of proximal development' since collaboration with group members as well as the mentor is regarded important for achieving research objectives.

V. Discussion

When we look at the lives of highly successful and eminent people, we find that most of them have met a mentor in their important time of life (Torrance, 1984; Kaufman, Harrel, Milam, Woolverton, & Miller, 1986). Mentorship program is one vehicle that enables gifted students to meet an important person, mentor. Research on mentorship program has shown its influence on various aspects of the mentee (Hebert, & Olenchak, 2000; Renzulli & Reis, 1994; Shaughnessy & Neely, 1991).

Results from mentorship programs showed some benefits of mentorship for the participants, including cognitive development as well as affective development. These findings suggest that mentorship programs should be actively applied as an appropriate educational approach for gifted students.

There are pitfalls of unstructured mentorship which imply that some assistances or services should be provided for mentees prior to their participation in

mentorship program (Clasen & Clasen, 1997). Renzulle and Reis (1994) also found that providing training on Type I and Type II Enrichment was effective for those who want to take part in high-level investigative activity such as mentorship program. In this respect, students need to be trained with regard to exploring their interest areas and topics as well as developing thinking and research skills.

In addition, more autonomy needs to be provided for the mentees to select the research topics by themselves. Once their interest is reflected in the research topic, students will be intrinsically motivated to participate in the project. The fact that most of the mentees expect the improvement of creativity from mentorship programs indicates that mentors as teachers should be trained on or familiar with instructional methods that facilitate development of creative skills.

On the basis of the mentorship programs including KIGES mentorship experience as well as the learning theory of social constructivism, a mentorship model was proposed to structure the mentorship process, which might facilitate the process between mentor and mentee. This model needs to be further supported by empirical research on mentorship programs.

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KIGES의 사사교육 프로그램에 기초한 사사교육 모형 개발

성현숙, 이상천, 허정윤, 우정수

심화교육의 한 형태인 사사교육은 21세기를 주도할 과학영재들에게 적합한 교육방법으로 알려져 오고 있다. 사사교육은 과학영재들에게 멘터와의 긴밀한 관계 및 연구를 통해 자신의 능력 및 과학자로서의 태도를 기르는 데 도움을 주고 있다. 경남대학교 과학영재교육원 (KIGES)은 지난 5년간 사사교육 프로그램을 운영해 오고 있다. KIGES의 경험을 포함하여 사사교육이 과학영재에게 제공하는 이점들을 토대로 사사교육 모형을 제안하였다. 이 사사교육 모형은 향후 사사교육 참여자들에게 사사교육의 과정을 용이하게 할 뿐만 아니라 사사교육의 효과를 증진시키는 데 도움이 될 것으로 사료된다.