Development and Implementation of 'Inventories of Evaluating Science Gifted Education Programs' - Centering Around SNU Science-gifted Education Center

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Abstract

Seoul National University has started science gifted education program since 1998, and asked for evaluating it. The inventories of evaluating for the observers, students, and teachers are developed based on the elements that gifted educators have insisted as gifted programs must have. Nine programs of the SNU Science-gifted Education Center have been checked using those inventories. The Objective of this evaluation is to confirm whether the SNU Science-gifted Education program is reflecting science gifted students' abilities and their educational needs as well, or if it'll be able to achieve its goal of developing students' maximum potential and foster future scientists as self-leading learners. It was found that these inventories for students, observers and teachers were useful in evaluating the science gifted education program. It is expected that checking programs step by

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step, finding which changes would be needed, correcting and complementing can build up bases of our country's gifted education growth in quality as well as in quantity.

Key Words: Lesson evaluation, Science Gifted Education, Inventories of evaluating,

Ⅰ. Introduction

Since gifted education had begun in Korea, the number of gifted education programs has been increasing rapidly. Gifted education centers are in the 23 universities and numerous districts; in fact, education is not being provided with evaluating and improving what and how are being taught. The researchers against gifted education have claimed special programs for the gifted caused gifted students to have elite consciousness and selfishness (Coleman and Fults, 1985). To make our gifted education successful and not to follow this negative flow, we need substantial evaluation and checking on the educational contents and processes. It is difficult to provide better program without reflection about the program provided, so the program evaluation is the point of finishing and new beginning of program (Park, 2003). Only this substantial checking can support the studies in which the participation of gifted program shows the long-term and affirmative effects (Lubinski & Benbow, 1994; Swiatek & Benbow, 1991), and it is the way of achieving the goals of gifted education. Fetterman (1993) stated that gifted education program must have clear and reflectional realization about its goals and traits than any other program; Borland (1997) emphasized improving

program is very important in the matter of educators' specificity and morality, and this can be done through program evaluation.

Borland who published 'Re-thinking of gifted education (2003)' said the new millennium is leading us to personal and special lives; therefore, we need to check on our education in the flood of knowledge. He also emphasized the future gifted education has to include the chances that students learn at the speed and pace making appropriate challenges, deep and improved contents, challenges on learning independently, considerations about interests and learning styles, and various learning opportunities centered on morality. Also he said we need to consider seriously how to help gifted students' acquisitions of self-controlled and self-initiated learning in this generation of explosion of web-knowledge. At the same time, we need to teach students how to access this information using the techniques of synthesis, analysis, and evaluation.

At this point of changing directions in gifted education and study, we need to check now if our science gifted education programs are appropriate for science gifted students' abilities and their needs, and they are using appropriate teaching-learning methods that can develop students' potentials and foster future scientists.

In the SNU Science-gifted Education Center, professors or instructors are in charge of each lesson unit. In fact, the reflection of the program remains as an assignment for us. It is hoped that we reflect and improve our science gifted education programs through this program evaluation research.

The purpose of the study is to develop Inventories for evaluating the gifted education programs and implement evaluation. This study is composed of five parts as followed.

(1) The literature review to find our differentiating facts analysis of science gifted education program.
(2) Producing 'Student's Inventory' for lesson evaluation of science gifted program.
(3) Producing 'Observer's Inventory' for lesson evaluation of science gifted program.
(4) Producing 'Teacher's Inventory' for lesson evaluation of science gifted program.
(5) Implementing evaluation using these Inventories.

Ⅱ. Literature Review

A. Gifted Education Program.

Many researchers (Kaplan, 1986; Maker and Nielson, 1995; Tomlinson, 1996; Van Tassel-Vaska, 2003) found that differentiated programs should be provided to gifted children, and it means, when programs are developed for gifted students, their traits have to be considered and the programs designed accordingly should be provided. Van Tassel-Baska (2003) said gifted students' learning needs are different because of their various abilities, so the contents of program for gifted students should be differentiated accordingly. Van Tassel-Baska (2003) presented five factors of differentiation: (1) Symbol system including abstraction at high level is suggested. Because of high ability of abstraction gifted students have, re-formation of basic curriculum and/or introduction of

new symbol system are required. (2) A longer time frame focusing on the exciting and challenging tasks is required because of gifted students' concentration, and it requires flexible time frame for special projects, and the activities of small group. (3) Gifted students have relation-formation ability in uncomparable data; therefore, exposing of compositive and various range and viewpoint is required, and it means, providing opportunities of interdisciplinary curriculum and use of various materials and resources are needed. (4) Because they have the ability to learn quickly and remember well, quick coverage of basic functions and providing of new learning sphere is required. (5) Because of their large amount of information and various interests, choosing opportunity according to interests and profound study of chosen field are required, and it accompanies the need of self-directed learning opportunity and personal learning plan.

The United States Department of Education(1993) defined differentiating in quality for gifted students: (1) It has to include the contents and processes that make higher thinking skills possible. (2) It has to apply teaching-learning strategy satisfying gifted students' unique learning styles. (3) It has to include adaptability applying for various instructing method, such as seminar, special class, independent study, teacher-parents system, field trips, library media research, and so forth.

Kaplan (1986) also suggested the main points of differentiation, those are a) various alternative products, b) more extended, associated and profound contents, c) the emphasis of higher thinking skills, d) using various materials, e) more opened, abstract, and complicated, f) filled with analysis, g) elimination of ceiling effects, and h) teacher's role as a promoting person.

According to Maker and Nielson (1995), to develop education program for the gifted students, differentiating should be achieved in the contents, processes, products, and environments. The details are as follows.

1. The contents.

Abstractness: From concrete to abstract knowledge, if we divide them four levels as facts level, concepts level, generalization level, and theory level, educational contents for the gifted students have to focus on more than facts and concepts level.

Complexity: The gifted students with a lot of curiosity, who is finding unexpected relations, and who has excellent sense of humor, are said to get much help from complex contents. The complexity of educational contents can develop overall and systematical methods easily in the constituting knowledge.

Variety: Students who have much interests like inquiry very much, understand the relation among things or concepts quickly and deeply, can get much benefits from various contents using their imagination and creativity. Creativity, curiosity, and task commitment make the gifted students participate in various learning activities (Maker and Nielson, 1995).

2. The process.

According to Maker and Nielson (1995), process means thinking process which expecting students use, the gifted education process must expand the students' creativity and higher thinking skills, and must help gifted

students to use and manage knowledge effectively that they have already acquired. Especially, among the thinking abilities presented in Bloom's Taxonomy of Cognitive Objectives, using higher thinking abilities such as application, analysis, synthesis, and evaluation, as well as effort to expand logical problem-solving skills and critical thinking skills are needed. Also, while emphasizing creativity using imagination and brain-storming, students have to get the delight of discovery, acknowledge and draw their own conclusions.

3. The products.

Products mean the things students make as a result of the process. The gifted education has to provide opportunities for students to make products showing their potential. It is important that providing experiences treating practical problems and new problems around our lives are good enough for students. To find problems in real life situation includes the analysis of the situation and clarifying problems, and transformation of information rather than using as it is. Finally, self evaluation and practical audience evaluation about process and products have to be achieved.

4. Learning environment.

The learning environment means both psychological and physical. The environment has to be built up for students to acquire knowledge and reveal their maximum abilities. The students should be the center, focusing on the student's interests, concerns, and ideas rather than

the teacher's. It requires an open atmosphere of accepting new person, materials, ideas before evaluating and criticizing it. Here, various and plentiful materials, media, ideas, teaching methods, and tasks are included. Even encouraging students' rambling, so to speak, rambling from in or out of the group, from desks, in the classrooms, is included among the elements of the learning environment.

Following are the points selected from teacher's training material (Korean Educational Development Institute, 2004) about the gifted education program differentiation.

1) Science gifted education program has to be organized with the direction of expanding creativity and problem-solving skills. If we consider it is possible when students concentrate on their favorite subjects, the gifted program has to provide challenging and interesting activities. Therefore, it is important to provide opportunities for students to organize their entire process of inquiry such as materials, learning tools, methods, and evaluation as well as study problems.

2) Another emphasis is to organize lessons in order to cultivate self-directed learning abilities. One of the important educational objectives is to give students self-leading and self-control learning abilities, and to help them study independently without the help of the teachers or parents. Especially, for the gifted who should be future social leaders, it is very important.

3) Emphasizing of emotional aspects, education should be focused on producing a well-rounded person. Till now our country's education has been focused on knowledge, especially because of entrance examination stresses. Even knowledge education hasn't been freed

much from the memorizing level. Therefore, the needs of educational changes emphasizing the emotional aspects is presented. Students should learn not only creativity or problem-solving skills but also how to respect other's abilities, cooperate, overcome difficulties patiently, with the higher thinking abilities. (Clark, 2002). Discussing, role playing, opinion research, and interviews have to be included, and have to cultivate cooperation through group activities.

B. The Program Level: Balance between acceleration and enrichment.

When we consider the gifted students' learning speed, to shorten time is more necessary than learning in the general formal education process (Park et al., 2003). Because acceleration is proceeding according to their abilities, students would not feel discontent about boring lessons, and it is very affirmative in educational effects (Stanley and Benbow, 1986).

Enrichment means, through expanding curriculum profoundly and extensively, to provide students learning experiences that they can't get through the regular curriculum (Park et al., 2003). The aims of enrichment are to promote the gifted student's creative thinking abilities, to develop special talents, to develop and expand their potential. Students participate in various activities such as field trip, individual project, expert's mentorship, and Saturday and summer gifted programs and so forth (Park et al., 2003).

According to Clark (2002), enrichment learning is focused on expanding of higher thinking skills, and it is

important to teach research skills, critical thinking skills, and meta cognitive skills.

According to Park et al. (2003), because the gifted students need both acceleration and enrichment, we need to unify acceleration and enrichment or use them as mutual complementary elements of curriculum rather than dividing them. Therefore, curriculum has to be composed as enrichment-acceleration which can stimulate gifted student's intellectual curiosity and expand their scientific thinking abilities and creativity (Kim, 2002).

C. Scientific thinking skills.

1. Convergent thinking is based on Bloom's (1956) Taxonomy of Cognitive Objectives.

Bloom (1956)'s Taxonomy of Cognitive Objectives can be a precise model in analyzing cognitive aspects such as memory, thinking, problem-solving and so forth. It is divided into six acknowledgement aspects of knowledge, understanding, application, analysis, synthesis, and evaluation. Evaluation centered on knowledge, understanding, and application is being performed at school, but in the gifted education program, higher thinking abilities such as analysis, synthesis, and evaluation are emphasized (Shin, 2004). According to Shin's proposition, each aspect is as following.

- Knowledge is the lowest sphere, and is said to include concrete knowledge; knowledge about methods and means treating the concrete things; knowledge about general and abstract things in the specific fields.
- Understanding, includes translation, interpretation, and reasoning.

- Application sphere means using certain abstract concepts accurately when given new problems in the situation of non-giving solution.

- Analysis abilities are essential to deciding material traits, deciding mutual relation among found elements.

- Synthesis sphere is to synthesize certain system or form that hasn't existed before through taking out elements in various materials.

- Finally, the most upper sphere is evaluation. The evaluation sphere is to judge values, ideas, works, answers, methods, and subjects with certain purposes.

2. Divergent thinking will be treated only four creative elements among the elements Guilford (1967; Clark's recited) claimed and Torrance (1988) used widely.

Referring to Shin's proposition, firstly, it is fluency, or quantitative ability related richness of ideas producing as much ideas and solutions as possible. Second, it is flexibility producing various and wide range of ideas, breaking and transforming viewpoints, visions. Third, originality, the ability to produce rare, novel, and unique solutions, and it is the ultimate aim of creativity. Finally, elaboration can be pointed, which is the ability of developing and expressing proposed ideas, and it means thinking abilities that can understand the meaning of problems and complement the lacking points and treat them elaborately.

B. Science Inquiry Skills.

Germann et al. (1996) said when students participate in real science activities independently, it is the most upper level study. According to Chinn and Malhotra (2002), real science activities are those activities that scientists perform in their study actually, and simple study is found in the science education of our school science activities (Shin, 2004). The following is Shin's proposition of science inquiry as general experimental process.

1) Pose study problems: Study problems are presented by himself in real science activities and study problems are given to the students in school science activities.

2) Planning experiments: Planning experiments has four aspects; selecting variables, planning experiment process, control of variables, and planning measurement.

3) Observation: Scientists use observation process focused on accuracy.

4) Explaining observation results: To form interpretive data, coding and re-coding, diagrams, tables, summary, mathematical transformation, or observation results for statistical analysis, finding methodology and interpretation faults, indirect inference, so it is very complicated inference needed developing explanatory model.

5) Theory development: It has two aspects, theory level and settlement of experiment results.

E. Emotional Aspects.

Terman and Oden (1959) investigated

accomplishment level when the gifted children became adults, as his tracing study, the success deciding factor between the successful group and unsuccessful is not the differences in cognitive abilities but tenacity and willpower to achieve his or her goals. According to VanTassel-Baska (2003), differentiated guide satisfying the gifted students' unique social and emotional development has to be provided. Also, it is important that educational emphasis on socio-emotional aspects be accompanied with the cognitive aspects in the gifted education program. Taylor (1986) has emphasized communication skills to improve students' cognitive learning talents. Communication skills are centered on using and interpreting language, or non-language forms of communication to express ideas, emotion, and requests. Similar to this, Choe (2004) emphasized in his keynote address at a conference on giftedness, mutual complemental emotional aspects in improving cognitive learning abilities as seven Cs. Cognitive development is difficult to achieve and has no meaning without cooperation, negotiation, and responsibility. However, Borland (1989) pointed out the lack of education program considering the gifted students' social emotional traits in the gifted education program.

III. Research Method

Through the literature review, important factors of differentiating gifted program were found, and teacher's, observer's, and student's inventories were constructed based on these factors. It was accomplished with the teachers participating in the excellent science teachers

study and training program. We spent about 8 weeks in contemplating the theoretical backgrounds, and the pilot tests have been taken place. Spent 4 weeks in correcting and supplementing the first inventories. To confirm the validity for the subordinate items of inventories, 2 professors in Science Education and 19 Science teachers checked. A total of 9 programs out of all of the SNU Science-gifted Education Center's programs were evaluated using these completed inventories. The programs that are evaluated are as follow: Lights and colors, Observation of vacuum and electric discharge, Lies are visible, One substance into many, Directions for the microscope, Vinegar fly and mutation, Structure and Function of eyes, Observation of the ocean using WEB, Experiment using MBL. After analyzing evaluation materials and reflecting on them, gifted education programs have been improved and complemented. Foe the student's inventory, 19 or 20 students participated from each class, and 9 teachers participated separately to complete the teacher's inventory. For observer's, between 2 to 10 teachers, who were in the training program, participated in each section and these observers were experienced and trained teachers so that their view points were assumed to be reliable.

IV. Results

A. Structure of the Inventories.

The observer's, teacher's, and student's are developed based on the elements that gifted educators insist as gifted programs must have.

Domain	Contents of Evaluation	Student's	Teacher's, Observer's
Objectives and Level of the Program	Program Objectives		1
	Program Level	1	2
Cognitive Domain	Inquiry, Methods, Creativity		3,4,5,6,7,8,9 ,10,11
Social-emotional Domain	Interests, Challenged, Cooperation, Communication	2,3,4,5,6	12,13,14,15, 16
Teaching-Learning Strategies	Self-Directed, Materials	7,8,9	17, 18, 19
Others	Suggestions	10,11	20,21

B. Results from common inquiries.

The questions that jointly correspond to the inventories for students, observers and teachers are presented with a table as follows.

Inquiries about the level of lessons were made to observers and teachers using the words of acceleration and enrichment. However, for students, enrichment was changed into "Though the contents had been learned at school, more diverse materials and activities were provided here", and acceleration "Though contents had not been learned at school, those were not so difficult", and the results are as follows.

Almost half of observers, teachers, and students marked SNU gifted programs are enriched, and only students considered some are accelerated or some are materials that have not taught at the school.

Table 1. Answer rate on the level of lessons

Answer type	Answer rate(Unit:%)		
	Students	Observers	Teacher
① There was no difference from a regular classes.	0	0	0
② Acceleration course was reflected.	31	16.7	0
③ Enrichment course was reflected	40.5	45.8	50
④ Acceleration and enrichment course were reflected.	0	26.5	50
⑤ There was content, not taught at school and very difficult.	25	0	0

The evaluation of social-emotional aspects was to be checked by 5-point Lickert scale, and the results are showed in Table 2.

Most of teachers, observers, and students considered many lessons were fresh and interest, however, it was revealed the programs do not emphasize social responsibility.

Table 2. Average comparison of students, observers and teachers on the development of social-emotional aspects of the program

Inquiries	Average		
	Students	Observers	Teachers
Cooperation and communication among team members	3.9	3.5	3.2
Freshness and interest of lessons	4.1	4.1	4.2
Challenge and a spirit of adventure	3.1	3.6	3.0
Patience and tenacity	3.5	3.7	3.2
Social responsibility	2.7	2.3	2.4

Evaluation results of teaching-learning aspects are showed in Table 3.

Table 3. Average comparison of students, observers and teachers on the teaching-learning aspects of the program

Inquiries	Average		
	Student	Observer	Teacher
Autonomous problem-solving process	3.8	3.9	3.8
Appropriate offering of learning tools	4.4	4.2	4.2
Appropriate arrangement of learning order	4.1	4.0	4.0

Most of teachers, observers, and students considered the programs offer appropriate learning tools and self-directed problem-solving process, and appropriate arrangement of learning order as well.

B. Results from student's

Most students considered SNU Science gifted programs are enriched even though some are accelerated and have not taught at the school, however, they assumed the programs were interest and offer self-directed problem-solving process and appropriate learning tools in appropriate learning order.

They also presented that they have been changed in an existing ideas or attitudes, and some students answered that they were able to know the importance of experiments, even complicated, or the seriousness of global warming and its solutions, and so on. Also, the students answered with regard to the matters to be recommended in contents or processes. There were lots

of comments stating that there was so much to be done and it was very difficult or students wanted to take more lessons using MBL, and so on. Useful information to refer to in planning classes was collected.

C. Results from observer's and teacher's

Inventories for observers and teachers are composed of same inquiries and the results are as follows.

With regard to coincidence of the lessons with lesson aims, it was evaluated by checking 5-point Lickert scale.

Table 4. Coincidence with lesson aims

Answer type	Answer rate(Unit:%)	
	Observer	Teacher
① Lesson aims were exactly proposed.	0	0
② Did not coincide.	0	0
③ Coincide.	14.7	0
④ Relatively coincide.	44.1	45
⑤ Very much coincide.	38.2	55

While observers variously marked, both teachers and observers considered most lessons accorded those aims.

With regard to convergent thinking, it was revealed as follow.

Table 5. Convergent Thinking

Answer type	Answer rate(Unit:%)	
	Observer	Teacher
knowledge	21.6	22.7
understanding	22.5	22.7
application	22.5	18.2
analysis	18.9	18.2
synthesis	14.4	18.2

Relatively even distribution is shown.

Duplicate answers could be given in divergent thinking, and the results are in Table 6.

Table 6. Divergent Thinking

Answer type	Answer rate(Unit:%)	
	Observer	Teacher
① Creative thinking is required.	64	56
② Various ideas or proposal of a solution is required.	45	56
③ Delicate and precise ability is required.	77	78

Duplicate answers could be given in relation to contents of lessons. It was revealed that among science inquiry skills, 'observation and drawing conclusions' were most required, followed by 'designing experiments', and 'control of variables' and 'data interpretation' were less emphasized, and activities such as classification, reasoning and building up a hypothesis were least required.

With regard to difficulties or recommendations on contents or progress, lots of direct recommendations were proposed such as a) if styrofoam size was smaller, experiment installation and results might appear well, b) it was difficult experiment due to the strong electric light, c) the amount of dry ice or Freon gas must be balanced for an experiment to be made.

V. Conclusions and Implications

The programs of SNU Science-gifted Education Center were found to be more of an enrichment program than

acceleration program providing diverse inquiries and activities. Even though students said that content not covered at their schools was more than 50 percent regardless of the difficulties, they considered it as an enrichment program while observers and teachers considered acceleration and enrichment having been simultaneously conducted.

The program content was considered to be new and attractive. It was shown that there was content related to daily lives, and introduced recent scientific research trends and scientific history or philosophy. However, there was little introduction of occupation-related content, which was recommended. It also has been revealed that cooperation and communication among team members were made actively. While the classes required tenacity, spirit of challenge and adventure, social responsibility was not emphasized at all. Teachers who participated in evaluation either as an observer or as a teacher realized that we need to emphasize social responsibility in the classes.

Also, it appeared that the lessons were appropriately arranged with a lot of autonomous problem-solving processes and it was revealed that knowledge, understanding and application were a little more emphasized than analysis, synthesis and evaluation which gifted educators suggested as higher thinking skills. Therefore, higher thinking skills were found to be emphasized more in the programs as gifted educators proposed.

Though it was revealed creative ideas or diverse solutions were required, delicate and precise skills were more required in the classes. The necessity to emphasize creativity instead of precise skills was found.

Overall, it was exposed the Inventories for students, observers and teachers were useful in evaluating a scientific gifted educational program from various aspects. Through such evaluation, it was possible to analyze differentiating factors for science gifted educational program and to reflect on them when constructing the next program, which will be helpful for more substantial education. It is expected to provide proper direction of evaluation to Science-gifted Education Centers in universities and districts. It is suggested that research on program evaluation should be conducted more actively and evaluation be a new method to improve programs.

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Appendix 1

Inventory of Evaluating Science Gifted Education Program (Student's)

This questionnaire is only for the research reference. Please read the followings and check "∨" for the correspond to your opinion.

Date of lesson: Name of program:

1. Where did today's lesson level correspond?
   ① It was almost same as school classes.
   ② It was provided to higher level than school.
   ③ Though the contents had been learned at school, more diverse materials and activities were provided here.
   ④ Though contents had not been learned at school, those were not so difficult.
   ⑤ Contents had not been learned at school, and it was very difficult.

2. Were cooperations and communications among group members accomplished well during class?
   ① Strongly agree. ② Agree. ③ Not sure. ④ Disagree.
   ⑤ Strongly Disagree.

3. Were contents of today's lesson new and interesting?
   ① Strongly agree. ② Agree. ③ Not sure. ④ Disagree.
   ⑤ Strongly Disagree.

What's the reason of your reply? Please write down.

4. Did today's lesson provide challenges and the spirit of adventure?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

5. Did today's lesson require patience and tenacity?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

6. Through today's lesson, could you think of social responsibility?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

7. Did today's lesson provide self-directed learning opportunities?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

8. Were learning materials provided appropriately during class?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

9. Was learning order arranged suitable for understanding contents of lesson?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

※ Appendix 2 >

Inventory of Evaluating Science Gifted Education Program (Observer's, Teacher's)

This questionnaire is only for the research reference.b Please read the followings and check "∨" for the correspond to your opinion.

Date of lesson: Name of program:
Observer:

1. Did today's lesson contents accord with the lesson objectives?

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

2. How was today's lesson trait level?

① It was almost same as school classes.
② Acceleration was reflected.
③ Enrichment was reflected.
④ Acceleration and enrichment were simultaneously reflected.
⑤ It was not suitable for the gifted because of excessive reflection of acceleration and enrichment.

* Please check "V" if you think following was included in today's lesson, and write the reasons and exemplifications.

3. There were contents related to science history and science philosophy.( )
<reason or exemplification: >

4. There were contents related to every day lives. ( )
<reason or exemplification: >

5. There was an introduction to recent science research trend.( )
<reason or exemplification: >

6. There was an introduction to related careers.( )
<reason or exemplification: >

7. Convergent thinking processes were required as following.
knowledge ( ) understanding ( ) application ( )
analysis ( ) synthesis( )
< reason or exemplification: >

8. Divergent thinking processes were required as following.
① Creative thinking skills were required. ( )
② Fluency was required. ( )
③ Originality was required.( )
< reason or exemplification: >

9. Inquiry skills were required as following.
observation ( ) classification ( ) measurement ( )
reasoning ( ) problem recognition( )
hypothesis setting( ) experiment planning( )
control variables( ) data interpretation( )

drawing conclusion( ) generalization ( )
< reason or exemplification: >

10. The lesson as following was proceeded.
① Every presented idea was accorded with scientific concepts.
② Scientific concepts were centered, but some of them were inappropriate.
③ Parts of lesson contents were not accorded with scientific concepts.
④ Most of lesson contents were not accorded with scientific concepts.

11. Today's lesson provided opportunities and zeal of self learning.
① The maximum of learning opportunities were provided in the aspects of time and frequency.
② Appropriate learning opportunities were provided in the aspects of time and frequency.
③ Inappropriate learning opportunities were provided in the aspects of time and frequency.
④ Opportunities of self learning was hardly provided.

* Evaluation scale:

① Strongly agree. ② Agree. ③ Not sure. ④ Disagree. ⑤ Strongly Disagree.

Contents of Evaluation questions		①	②	③	④	⑤
12	Through this program, students' cooperation and communication skills can be fostered.					
13	This program can induce students' interests with original contents.					
14	This program can induce students' challenge consciences.					
15	Through this program, students' patience and tenacity can be fostered.					
16	Through this program, students' social responsibilities can be fostered.					
17	Through this program, students' self-leading learning abilities can be fostered.					
18	Learning materials were provided appropriately.					
19	Contents and processes of this program were structurized systematically.					

20. Among today's lesson contents, what is the most interesting part, and what's the reason of it?

21. Regarding today's lesson, please write down any difficulties or recommendations.

* Thanks for your sincere reply*