New In-service Education Program on Science Experiments to Develop Professionality of Science Teachers

JaeYoung Han* · Jae-ho Sim[1] · Sung-Chul Ryu[2] · Hyuk Ihm[3] · Jung Hoon Choi[4]

Young-Joon Shin[5] · Jeong-woo Son[6] · Jun-Euy Hong[7] · Bookkee Hwang[4]

Chungbuk National University · [1]Korea Institute of Curriculum and Evaluation · [2]Nowon High School
[3]Wonmook High School · [4]Hanyang University · [5]Gyeongin National University of Education
[6]Gyeongsang National University · [7]Hansung Science High School

Abstract: The most important factor in students' growth and development is the teacher. Therefore in-service science teacher education to develop the professionality is important as well as the selection of new excellence teachers. Our research is on the development and application of new education program on science experiments where in-service teachers become the lecturers in the program and provide information that is bound to the context of real lessons. This program is consisted of following 10 steps of work, which was implemented in 5 months: sharing the philosophy of the program, selecting science experiments, first application of the experiments, discussion on the first application, learning how to edit the movie clips of the lesson, second application of the experiments, in depth discussion on the second application, developing the experiment package, giving lecture to other science teachers, and evaluating the program. We describe the process of the program developed and implemented in detail to suggest a model of science teacher education program on science experiments and discuss educational implications. This program is characterized by the emphasis of the context closely linked to the real lessons, the problem solving in a real situation, and the collaboration of teachers, professors and science education researcher in a teacher education.

Key words: In-service teacher education, Science teacher, Professionality

I. Introduction

In-service teacher education is one of the key issues of science education nowadays. In-service science teacher education is important to the professional development of science teachers (Kim, 2007). Therefore many educational research and practice have paid attention to the in-service teacher education (Kim, 2007; Marx et al., 1998; Munby & Russell, 1998; Park & Choi, 1997). The research on the in-service education program tried to find problems in the program and suggested methods to improve the program (Kim & Kim, 2005; Yeau et al., 2003).

The reported problems in teacher education program include the compulsory participation to the education and the unrealistic contents of education program (Kim, 1999; Yeau et al., 2003). New teachers in Korea should participate in at least one in-service education program to get the first-class teacher certificate. This program is managed by the government, and all teachers who have the second-class teacher certificate are obligatory to pass the program like the “ceremony of passage” (Kim & Kim, 2005). That is, the program for the first-class certificate is pre-planned without the consideration of the needs of participating second-class teachers or lecturers. This official program is, therefore, criticized being ineffective to the professional development of second-class teachers (Kim et al., 1991). The problem of compulsory participation and the resulted ineffectiveness is hardly solved unless the teachers participate to another in-service education program voluntarily.

Teachers who have experienced an in-service education program often ask the contents of the program should be linked closely to the real setting

*Corresponding author: JaeYoung Han (jyhannn@chungbuk.ac.kr)
**Received on 17 September 2008, Accepted on 18 November 2008
***This work was supported by the Korea Research Foundation Grant. R14-2003-040-01000-0

of school education. When the contents of in-service education program are separated from the real situation of school, the teachers participating in the program may feel there is a little to learn. This is the problem of “context” of teacher education (Munby & Russell, 1998). This problem can be lessoned by cautious lineup of lecturers in the program. Recently, many in-service science teachers themselves are invited to become the lecturers in teacher education program. The in-service teachers can provide resources that are bound to the context of real lessons.

However, the lecturers as teachers have difficulty to prepare lectures and also want to develop their own professionality. This is the point where the collaboration is required between teachers (lecturers) and university researchers. The professors can help teachers to prepare lectures for in-service education. At the same time, the professors can access to the real context of education and to the professional development of in-service teachers.

Considering these points, we developed and implemented new kind of in-service science teacher education program on science experiments. We tried to find the clues to solve the following questions: What are the steps of new in-service program to develop the professonality of both lecturers and teachers? How can the contents of in-service science teacher education program be closely linked to the context of real lessons? How can the in-service teachers teach other in-service teachers? By describing the process of in-service program in detail, we suggest a model of science education program for the future.

Ⅱ. Methodology

This study covers more than four years of research and development in science teacher education. One university located in Seoul has hosted science education research center funded by the government. The science teacher education is one of four projects of the research center. The authors of this paper include in-service science teachers, professors, and science education researchers, who have participated to this project for several years. Thus, all the authors are familiar with the situation where the in-service education program on science experiments is planned and implemented.

The in-service science teacher education program on science experiments consisted of three levels of the beginning level, the intermediate level, and the advanced level program. We describe the advance level program in this paper. The advanced science teacher education program on science experiments was implemented from September, 2006 to January, 2007. The authors participated to the development and implementation of this advanced program. We designed the program together, observed what was taking place in the program, recorded the processes of the program, discussed what to do next, and reflected what was done, etc. That is, we used the method of real "participant observation" in this study (Cho, 2005).

We gathered many source of data including video clips of some steps of in-service education program, video clips of real lesson of in-service teachers participating in the program, teaching plan of the lesson, students' worksheets, voice record of discussions, field notes, etc. These data are combined together in describing the program, and in understanding what was going on in each step of the program. For example, the students' worksheets were referenced to check how the students responded to the experiments (See the “7. In-depth discussion on the second application” in the result section.).

The first author videotaped several steps of the program. Then he played back the video clips many times, selecting the representative moments, and transcribed the selected parts. The result of this preliminary analysis was discussed in both off-line meeting and on-line webpage (board). In addition, the program was presented in three different science education conferences where disinterested science education researchers shared the result and provided feedback. All of these processes are recorded in the research note to construct an audit trail that assures the quality and credibility of this kind of qualitative research (Guba & Lincoln, 1989; Roth, 2005).

We will describe each step of the advanced science teacher education program on science experiments developed and implemented in this study. This study follow the tenet of phenomenological research in

education (Cho, 2002), so that the descriptions in the following result section work as an exemplary description to show readers what was going on in our program. We also discussed educational implications from the descriptions.

Ⅲ. Results

The lecturers as teachers have difficulty to find time for preparing lectures. Teachers are tied to the time schedule of their schools, so the in-service education usually held in the vacation. However, to give a lecture in a program held in the vacation, the lecturer has to prepare the lecture during the semester. All the following steps except the last two were implemented in the middle of the second semester, 2006. Nevertheless, when we announced this new kind of in-service program at the science teachers' association located in Seoul, ten teachers applied for the program. Although the teachers volunteered to participate, two of them gave up the program in the middle because of the time pressure. This shows the program was not easy to complete. Table 1 summarizes ten steps of in-service program and short explanations of each step.

Followings are the detailed description of each step. The discussion for each step is also presented. In the discussion we tried to find the meaning and/or the importance of each step referring to the literature.

1. Sharing the philosophy of the program

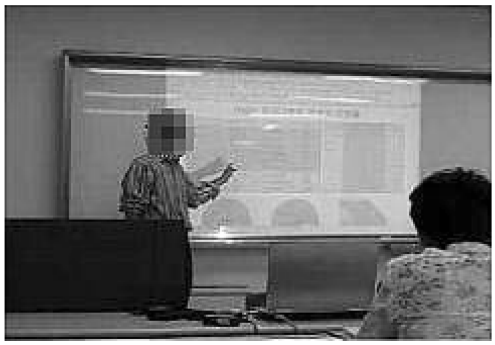
Description: Teachers who volunteered to participate in this advanced level program attended to 2 hours of lecture (on Sep. 21, 2006) to share the philosophy of the program. The philosophy of the program is abbreviated to HASA, 'Hands, Head, and Heart at Science Activity.' This is also the basic philosophy of the research center which supports this in-service education program. The science activity developed in this research center aims to improve students' scientific inquiry skill (i.e., ‘Hands’), scientific knowledge (i.e., ‘Head’), and scientific attitude (i.e., ‘Heart’) at the same time. The HASA experiments are based on the hands-on activity of students. Students need to handle the apparatus or the material in HASA experiments.

Fig. 1 shows the moments of the first step of this program. The lecturer in Figure 1a is a science education researcher. He was explaining the philosophy of the program with the PowerPoint presentation

Table 1
In-service science teacher education program

Step	Duration	Explanation
1. Sharing the philosophy of the program	2 hours Sep. 21, 2006	Participants discuss the philosophy of the program, HASA in free environment.
2. Selecting science experiments	2 hours Sep. 21, 2006	Participants select new science experiment to gather informations from application.
3. First application of experiments	4 hours Sep. to Oct. 2006	Participants apply selected experiments to their classes, and write a reflective report.
4. Discussion on the first application	4 hours Oct. 26, 2006	Participants discuss on the first application with each other exchanging many informations.
5. Learning how to edit movie clips	1 hour Oct. 26, 2006	Participants learn the way videotaping their lessons and editing the movie clips.
6. Second application of experiments	4 hours Nov. to Dec. 2006	Participants apply selected experiments again, and videotape the classes.
7. In-depth discussion on the second application	8 hours Dec. 7 & 18 2006	Participants discuss on the second application in detail using video clips.
8. Developing an experiment package	2 hours Dec. 2006	Participants develop experiment package to use in the lecture at the intermediate level program.
9. Giving lecture to other teachers	2 hours Jan. 4 & 5 2007	Participants give lecture to other science teachers in the intermediate level.
10. Evaluating the program	2 hours Jan. 5 2007	Participants and researchers evaluate the whole process of the program.

a.



b.

Fig. 1 *A lecturer explains the philosophy of the program (a), while the participating teachers listen to the lecture or suggest an idea (b).*

Lecturer: The experiments developed under the HASA starts from the hands-on activity. Science activities should emphasize knowledge, inquiry, and attitude at the same time.

A teacher: When I applied (an experiment), when it was really interesting, students did it for themselves.

projected on the whiteboard. The lecturer stressed the science activity should raise students' scientific knowledge, inquiry skill, and attitude altogether. However, a teacher suggested from his experience that the science activity should be interesting most of all.

Discussion: *Importance of affective aspect in science experiment and importance of free environment in in-service program*

The HASA experiments emphasize the students' activities. In this point, the experiments can be thought as a student-centered program (Shin, 2004). For the lecturer's explanation on the HASA experiment, a teacher showed a partial agreement, but focusing on the affective value of science experiments. In this way, the lecturer's presentation can be reconstructed by the participating teachers. We can infer from the teacher's comment in Fig. 1 that the affective factor (e.g., students' interest) can be more important than the intellective factor (e.g., knowledge or inquiry).

The lecturer (one of the authors) and the participating teachers are all the member of the same science teachers' association. They know each other very well. This can contribute to the free environment of the in-service education program that affords free discussions and voluntary sharing of information. The director of any other in-service teacher education program should pay attention to the importance of this free environment, and try to foster such environment in the beginning of the education program.

2. Selecting science experiments

Description: The participating teachers selected science experiments which are new to them. The lecturer in Fig. 2, one of the authors, an in-service teacher himself, played a crucial role in developing the steps this program. He was explaining the purpose and advantage of the program (2 hours on Sep. 21, 2006). Teachers were invited to select an experiment considering their classes' grade level in order to apply the experiment to their classes.

Fig. 2 *A lecturer guides participants to select an experiment new to them.*

Lecturer: You will give a lecture to science teachers in the intermediate level. The lecture is not on the experiment you have developed previously. You should select an experiment developed by other teacher. Then apply the experiment to your class. The purpose of this advanced level is to provide practical information from your application of the new experiment.

Discussion: *Importance of lecturer's experience as a new user of an experiment*

Most of the participating teachers had developed science experiment(s) under the HASA. Therefore the teachers could already give lectures with the experiment that they had developed. Some teachers had even given lectures with their own experiments at the intermediate level program held in the previous year.

However, for this advanced level program, the participating teachers should select new experiment that they had no experience at all. When they apply new experiment to their classes, they will be confronted with a situation where new problems may occur. They can gather information to overcome those problems in a real educational situation. This information will be presented to other in-service teachers, who might be new to the experiments, at the intermediate level program that is scheduled in the later step of this advanced level program.

This point of the advanced level program, i.e., the pre-application of experiment and thus lecturer's (participating teachers') experience as the new user of the experiment, will solve in part the reported problem of the unrealistic content of teacher education program (Kim, 1999).

3. First application of experiments

Description: The participating teachers applied the selected experiments to their classes. The first application of experiment was performed during Sep. to Oct. 2006 (4 hours). The eight participants selected different experiment to each other, so that eight experiments were applied in 5 middle schools and 2 high schools located in Seoul or in GyeongGi province.

When the content of the experiment did not fit to the schedule of school curriculum, the participants had to prepare extra-class for the application. Some of the application classes were videotaped by voluntary student or another teacher, or with fixed video recorder. Thus, the videotaping was not executed systematically in this step.

Participants gathered students' responses and reports, and wrote the reflective report on the application. Some participants had asked questions to the original developer of the experiment before applying it (This was talked in the next step, discussion on the first application). The original developers are also the members of the same science teachers' association, so that they are willing to give information on the experiment. In this process, the original developers can also get feedbacks on the experiment.

Discussion: *Importance of gathering practical information to discuss*

Participants could learn by doing the application of the experiment new to them with the aid of original developers. This can be one aspect of their professional development, in a sense that they can expand their ability (Roth, 2002) on the new experiment. In addition, this step can play an important role because the participant could get practical information to be discussed in the next step from which they can improve the experiment on their own. However, the videotaping was not supported enough. This point should be improved in the future program.

4. Discussion on the first application

Description: The participants discussed on the first application of experiments with other participants and science education experts. The discussion was performed in a university lecture room (Fig. 3, Oct. 26, 2006, 4 hours). Participants and some of the authors had a dinner together chatting on small issues around the school life. Then, the participants' applications were discussed one by one with/without video clips. They exchanged information such as the method of experiment, the tip of managing class, and the way to purchase apparatus, etc. For example, in Fig. 3, the teacher presented the way she guided students' experiment.

The topic of the experiments in Fig. 3 was ‘making a small electromotor.’ Although the procedure of the experiment was given to students in the worksheet, they could not wind the wire easily. In making the small electromotor for the first time, it is difficult to wind a wire only from the method described on the worksheet. The teacher in Fig. 3 realized this difficulty from her application of this experiment to the real situation. So she said that she demonstrated the winding way, which was the crucial step in making the small electromotor. Another teacher agreed to this way of teaching referring to his own experience.

Fig. 3 *A teacher presents her application of experiment.*

Fig. 4 *A lecturer demonstrates the editing process.*

Teacher: I went to students and showed the way winding the wire in person. And then they could follow me.

Another teacher: (When I did the same experiment) I also wound the wire with students together.

Discussion: *Importance of discussion for overcoming difficulties in applying new experiment to actual school teaching*

The HASA experiments are based on the hands-on activity. That is, the information exchanged in this case is one of the key aspects of the experiment. This example in Fig. 3 also shows the advantage of the advanced level program where the contents of the program is closely linked to the real educational setting (Joyce & Showers, 1995) with which the participants discuss to overcome difficulties in the application. The information discussed in Fig. 3 was gathered directly from in-service teachers' experience, and was to presented later to other teachers at the intermediate level program. Such information bound to the real lesson could not have been produced without participants' application in this step.

5. Learning how to edit movie clips

Description: The participants learned how to edit the movie clips of their lessons and how to videotape their lessons. The same lecturer in Fig. 2 demonstrated the way editing movie clips with a computer software (Fig. 4, Oct. 26, 2006, 1 hour). The software is easy one to learn and use. He showed how to open a movie file, to cut and paste, and to change the size, etc. The participants are required to be able to edit their own video clips into a short video file for the discussion and for the lecture at the intermediate level program.

The lecturer in Fig. 4 said that two or more video recorder is required in order to record a lesson effectively. For example, one recorder is placed on the rear of the classroom fixed to the teacher, while the other one is manipulated by an independent man to follow the important moments or the locations such as students asking questions or doing the experiment. However, with the equipment and human power limit, more than one recorder was hardly used in this advanced program. This point should be reinforced in the future program.

Discussion: *Importance of videotaping as a starting point to be a reflective practitioner*

A professor or a science education researcher can help in-service science teachers videotaping their lessons in this step. The professor or researcher can have an access to the real lesson in this way and help in-service teachers develop their professionality in editing the video clip. As a photograph reflect the intent of the artist (Roth et al., 2005), the edited video clip shows the viewpoint of the editor who have selected only the part of whole lesson. The participants should make a decision where to cut or not from their lesson to use in the discussion of next step and in the lecture of the later step. Thus, the editing process can help the participants reflect on their lessons, and develop their professionality as reflective practitioners (Schön, 1983).

6. Second application of experiments

Description: The participants revised experiments from the first application and discussion, and applied them to another classes and videotaped the lessons.

The second applications were performed during Nov. to Dec. 2006 (4 hours). In this second application, the participants became more familiar with the experiments.

7. In-depth discussion on the second application

Description: The participants edited their movie clips and discussed again in detail on the second lessons with other participants and science education experts. It took about 1 hour to discuss the lesson of one participant. So the in-depth discussions of eight participants were performed in two days (on Dec. 7 and 18, 2006, over 8 hours).

All the participants played back their movie clips and stopped at the specific moments to initiate discussions. This way of discussion with movie clips follows the method of interaction analysis (Jordan & Henderson, 1989). The contents of the discussion include the difficulties in the experiment, information on students' characteristics, self-reflection on the lesson, and students' response on the experiment, etc. For example, the teacher in Fig. 5a raised the problem of managing students in the middle of the experiment. The experiment in the screen of Fig. 5a was dissecting the eyeball of a cow. When students start to anatomize the eyeball, they tend to focus on the experiment so that they cannot pay attention to teacher's additional explanation given in the middle of the experiment. The other participant also advised that all explanations should be provided beforehand.

The teacher in Fig. 5b reported that she could control students in her class by blowing up the balloons used in generating static electricity. In the previous discussion on the first application, she had said that students did not focus on the lesson because of the balloons. The other participant had said the balloon itself turned students' attention, so the balloon should have been taken away from them after using it. Thus the teacher in Fig. 5b followed this suggestion and could prevent this problem in the second application.

Discussion: *Importance of discussion with other teachers to develop in-service teachers' professionality*

These examples in Fig. 5 can constitute a kind of 'teaching repertoire' (Loughran et al., 2004) in teaching with experiment. The 'teaching repertoire' was gathered from participants' lessons, and was used in the lecture at the intermediate level program.

a.

b.

Fig. 5 *Teachers discuss the problematic situations.*

Teacher(a): When students are doing the experiment, it is useless to say something to them. It's very hard to control students then.

Teacher(b): As we had discussed before, I broke all the balloons.

All the eight teachers joined in these discussions. Therefore, we can infer that the participants can learn many things from the discussion not only on their lesson but also on the other participants' lessons. Thus, this step of the advanced level program can form a community where a group of teachers exchange information (Lord, 1994; O, 2005), and contribute to the professional development of in-service teachers participating in this program.

8. Developing an experiment package

Description: The participants developed experiment packages to use in the lecture at the intermediate level program. They improved the material of the experiment such as the students' worksheet and teaching manual (tips) to include all the information gathered from two applications and discussions on

the experiment. In addition, they re-edited the video clips when it is needed. These works were carried out individually in Dec. 2006 (2 hours).

9. Giving lecture to other teachers

Description: The participants gave lectures with the developed experiment package to other science teachers who participated in the intermediate in-service science education program. The intermediate level program was held at the university laboratory in Jan. 4 to 5, 2007 (2 hours).

The sequences of participants' lectures were different to each other. However most of the lectures included the following works: explanation of the purpose and method of the experiment, watching the edited video clip, guidance how to manage the class, presentation of the result of application, and sharing of the reflection on the experiment. The information presented in the lectures was based on the experiences of the lecturers as in-service teachers who had used the experiment in advance. That is, the information shared in the intermediate level program can be said as 'context-rich information.'

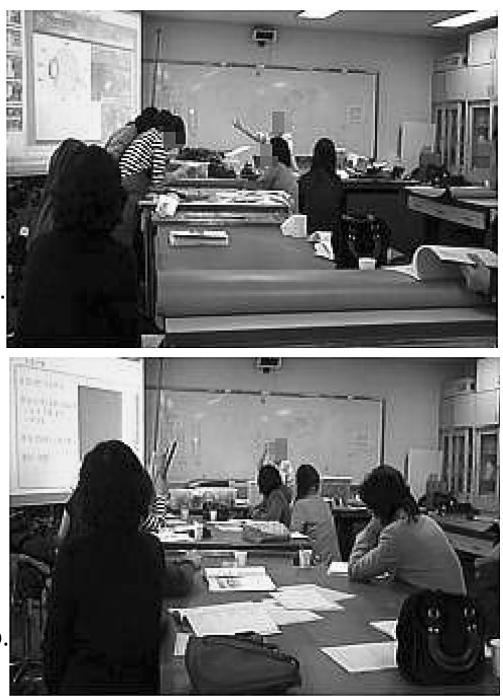


Fig. 6 *A teacher gives lecture at the intermediate level program.*

Teacher(a): It seems not so good to provide the result of experiment in detail. I could find (this) flaw when I saw the video again to prepare this lecture (in the intermediate program). I couldn't have had a chance to reflect my lesson if I only taught this experiment at school without the video recording.

Teacher(b): I recognized my voice went high like this (with her gesture) when I saw the video.

For example, the teacher in Fig. 6, whose experiment was dissecting the eyeball of a cow, is presenting information from her experience. The information, i.e., 'do not provide the result in detail,' is constructed from the reflection on her lesson with the video clip (Fig. 6a). She could also observe herself to find the characteristic of her voice (Fig. 6b).

Discussion: *Importance of real context in teacher education*

Researchers report that teachers often say they learned how to teach mostly in the first few years of their in-service experience, not in the university lecture for teacher preparation (Munby & Russell, 1998; Roth, 2002). This means the context of real situation is crucial to the professional development of in-service teacher (O, 2005). Thus, it can be inferred that this step of advanced level program can raise the professionality of both the lecturers (participants) and the in-service teachers enrolled in the intermediate level program, because the lecturer and in-service teachers give and take information based on the real situation.

In addition, we could also infer that the lecturers, for example the one in Fig. 6, took the step toward a reflective practitioner (Schön, 1983). All the lectures in the intermediate level program were also videotaped and the video files were provided to the lecturers for the future reflection on the lecture.

10. Evaluating the program

Description: All the participants and science education experts evaluated the whole process of the program (on Jan. 5, 2007, 2 hours). All the people took turns in pointing out the advantage or disadvantage of the program and suggested some methods to improve the program. All participants agreed to the fact that they had learned a lot in this program,

especially in the steps of two discussions on the application of experiment. Most of the participants mentioned that the video recording was very helpful to retrospect their teaching practices.

The most difficult point of this program for the participants was to assign their time for the program in the middle of the semester. All the off-line meetings except the final two steps started after the in-service teachers finished their work at school. Often the traffic congestion was time consuming. This point should be considered to be dealt with in the future program.

Some participants complained that there should have been more thorough discussion on the lesson. The researcher in Fig. 7a confessed that the plan of the lesson criticism was not realized well. The teacher in Fig. 7b did the work of managing the whole program. He wrote out the official documents, made the reservations of the university lecture room and laboratory, prepared the dinner, and took charge of the digital camcorder, etc. He, as an in-service teacher also, suggested these supporting works should be done by an formal assistant in the future program.

a.

b.

Fig. 7 *Participants evaluate the program.*

Researcher(a): In the first I planned to criticize the lesson more in detail. But I couldn't do it. It took about 4 hours to criticize one lesson.

Teacher(b, program director): Isn't it a tough course? We need an assistant who take full charge of the program, in order that the advanced level program continues in this form.

Discussion: *Suggestion for improving in-service education program*

Although we cannot measure the result of this program in a form of quantitative number, we can say every participant will remember this program as a valuable experience in his/her life.

Many suggestions were gathered for the improvement of the program. For the problem of time pressure, on-line discussion system (Suzuki, 2007) could lesson the time constraint in the future program. In addition, for the thorough discussion on the lesson, the time for the whole program should be extended or the number of teachers (lessons) should be reduced to do the fine-grained analysis of participants' lessons.

11. Summary of Results

With this study in which the authors developed and implemented the new in-service science teacher education program, we could extract several point that made the program 'new.' First, our program made some crucial steps in teacher education program both explicit and formal. The existing programs do not necessarily lay emphasis on the steps such as sharing the philosophy of the program with all the lectures or application of the experiment and the discussion with others based on the application. These steps of our program can contribute to making our program very consistent across the lecturers.

Second, our program highlights the importance of 'context' in teacher education. The second step, in which the lecturers select new experiment to them, is the starting point for this point. The lecturers could place themselves in new user's place of the experiment to gather informations for the lecture. The information gathered and discussed in the third to seventh steps are highly 'context-rich.' Thus, we could say that our program minimize the problem of unrealistic content of teacher education program.

Third, our program is new in a sense that the

program on the whole supports the lecturers' professional development of their own. The lecturers could experience many things in our program such as new experiments to them of course, discussion on their lessons, and reflections with video recording.

Now, let's return to the leading questions of this study. First, what are the steps of new in-service program? The initiate readers can make sense of the ten steps described with examples and discussed with inferences until now. Second, how can the contents of in-service program be closely linked to the context of real lessons? As discussed shortly ahead, we believe many steps of our program show the way in which the contents are bound to the context of real lessons. Third, how can the in-service teachers teach other in-service teachers? Never easy, but with the support from our program, researchers, and professors they could do.

IV. General Discussions and Implications

This study described the new model of in-service science teacher education on science experiments that is implemented along with the practice of education in real lessons. The significance of this study lies not only in the point that we developed new kind of in-service science teacher education program, but also in the point that we applied the program to the real education field, improved the participants' lessons, and provided a chance of participants' reflections on their lessons. The result of the application of this program will contribute to enhance the quality of the teachers' lessons who participated in the advanced level and in the intermediate level program.

Eight secondary school teachers completed this advanced science teacher education program on science experiments. They volunteered to participate in this over 30 hours program that is not easy at all. The participants became the lecturers of the intermediated level program, and provided information that is closely related to the real context of education. That is, this program is based on the real situation of the lecturers' lesson (Joyce & Showers, 1995). Thus this program can overcome the problem of unrealistic contents of in-service education. The planner of future in-service education may refer to the characteristics of this program such as using the video clip of lesson, lecturers' pre-application of the experiment, and discussion on the application, etc.

One of the participants asked to develop a manual to participate in this advanced level program. This paper can function also as a guide to teachers who will participate in the next advance level program. Science education researchers can get implication from this study (Kim, 2007); they should pay more attention to the real lessons to raise the reality of their lectures at in-service education. This seems to be a very important way to bridge the theory to practice gap.

New research is needed to understand the process of this advanced program more in depth. The participating teachers can be followed in detail to reveal the nature of professional development through the in-service education program. In addition, this program is worth to be compared with another science teachers' professional development program in other country (e.g., CPD programme in the UK, Kim, 2007; eLESSER, Suzuki, 2007).

This in-service program could not have been possible without the collaboration among in-service teachers, university professors, and science education researcher. All of these people spent a lot of time and effort to complement this program. This program was also possible with the support from the science education research center funded by the government. However, this program has many things to be improved yet. In order that this program continues, thus contribute to the professional development of in-service science teachers, the financial and administrative support should be provided continuously (Watson, 2004).

References

Cho, S. (2002). Phenomenology and pedagogy, Seoul: Wonmisa.

Cho, Y. (2005). Qualitative research methodology in institutional settings, Seoul: Kyoyook Kwahak Sa.

Guba, E., & Lincoln, Y. (1989). Fourth generation evaluation. Beverly Hills, CA: Sage.

Jordan, B., & Henderson, A. (1989). Interaction analysis: Foundations and practice. Journal of the Learning Sciences, 4, 39-103.

Joyce, B., & Showers, B. (1995). Student achievement through staff development: Fundamentals of school renewal. New York: Longman.

Kim, H. (2007). Requirements of a science teachers' professional development programme and a possible model. Journal of Korean Elementary Science Education, 26(3), 295-308.

Kim, J.-K., Kim, I.-H., Jeong, G.-J., Kim B.-G., & Koo, I.-S. (1991). Improvement ways for in-service training of science teachers. The Journal of Korean Association for Science Education, 11(1), 97-115.

Kim, S. (1999). Evaluating criteria development of continuing educational program for science teachers' professional advancement. Doctoral dissertation at Seoul National University.

Kim, Y.-T., & Kim, H.-B. (2005). An ethnographic study on the inservice education for the first-class teacher certificates. Anthropology of Education, 8(2), 1-30.

Lord, B. (1994). Teacher's professional development: Critical colleagueship and the role of professional communities. In N. Cobb (Ed.), The future of educational perspectives on national standards in America. (pp. 175-204). New York: College Board.

Loughran, J., Mulhall, P., & Berry, A. (2004). In search of pedagogical content knowledge in science: Developing ways of articulating and documenting professional practice. Journal of Research in Science Teaching, 41(4), 370-391.

Marx, R. W., Freeman, J. G., Krajcik, J. S., & Blumenfeld, P. C. (1998). Professional development of science teachers. In B. J. Fraser & K. G. Tobin (Eds.), International handbook of science education. (pp. 667-680). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Munby, H., & Russell, T. (1998). Epistemology and context in research on learning to teach science. In B. J. Fraser & K. G. Tobin (Eds.), International handbook of science education. (pp. 643-665). Dordrecht, The Netherlands: Kluwer Academic Publishers.

O, O.-W. (2005). Teacher professionality: Discussion on teachers as education professionals. Seoul: Kyoyookkwhaksa Publishing Co.

Park, J.-Y., & Choi, K.-H. (1997). The perceptions of teachers attended the second annual environmental education program for certification towards a second-major in environmental education. The Environmental Education, 10(2), 145-155.

Roth, W.-M. (2002). Being and becoming in the classroom. Westport, CT: Albex Publishing.

Roth, W.-M. (2005). Doing qualitative research, praxis of method. Rotterdam, The Netherland: Sense Publishers.

Roth, W.-M., Pozzer-Ardenghi, L., & Han, J. (2005). Critical graphicacy: Understanding visual representation practice in school science. Dordrecht: Kluwer Academic Publishers.

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Shin, M.-K. (2004). Changes in teachers' beliefs of science teaching and learning through inservice program experience focusing on student-centeredness. Journal of Korean Earth Science Society, 25(2), 53-62.

Suzuki, M. (2007). 'Science, education, tomorrow'. Fostering communication among people with the use of technology. Paper presented at 2007 International Conference on Science Education for the Next Society, Seoul, Korea.

Watson, J. R. (2004). Continuing professional development for inquiry: International perspectives. Paper presented at the National Association for Research in Science Teaching, Vancouver, BC.

Yeau, S.-H., Kang, S.-J., & Shim, K.-C. (2003). Investigation on the realities and teachers' perception of secondary school science in-service education. The Korean Journal of Biology Education, 31(4), 339-346.