

A Narrative Inquiry into Pre-Service Science Teachers' Reflective Thinking as Presented in Microteaching Lessons

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Abstract: This study aims to analyze how pre-service science teachers' reflective thinking is presented during the microteaching process. The subjects of this study were 13 students who attended a lecture course on science teaching methods offered by the Department of Science Education of the College of Education at a national university. The simulated lessons that were performed during the microteaching process went through peer assessment and self-assessment. Then, the next set of lessons was conducted based on the assessment results. After the first set of simulated lessons, the pre-service teachers' reflection at the routine and technical levels was most remarkable in the focus dimension. In the inquiry and change dimensions, technical reflection stood out. Dialogic or transformative reflection was rarely presented. In addition, most of the pre-service teachers displayed mingling patterns of reflection levels in all of the three dimensions. The results of this study, in particular, prove that microteaching has a high level of applicability in terms of reflective thinking and instructional technology. Accordingly, there is a need for subsequent studies to create a new model that can encourage pre-service teachers' reflective thinking by structuralizing peer and self-assessment during the process of microteaching.

Key words: microteaching, pre-service science teacher, reflective thinking, self-assessment

I. Introduction

Recently, reflective thinking has been regarded as a method of strengthening teachers' teaching competencies, which are very important in that they are directly related to the level of education that is attained. Thus, the issue of how to boost teachers' professionalism has become a major agenda in education. Regarding teachers' teaching competency, Shulman (1987) emphasized 'pedagogical content knowledge', which is the integrated form of teachers' subject matter knowledge and pedagogical knowledge. Moreover, Sch n (1983, 987) claimed that practical activities through reflection may contribute to the advancement of professionalism, stressing the need for a reflective process to improve teachers' professionalism. In addition, Feiman (1980) highlighted that teacher education should be helpful in developing teachers' ability to critically reflect on themselves, and other studies

of reflective thinking were conducted in this context(Richert, 1990; Russell, 1997; Valli, 1993; Zeichner, 1983). Zeichner and Liston (1987), in particular, criticized teacher education up to that time for hindering pre-service teachers' growth and failing to enable them to sufficiently improve their professionalism. The recent focus of teacher education has been on changing teachers' thinking processes, such as their decision-making and problem-solving abilities, rather than merely changing their behavior (Carter & Richardson, 1989). This trend holds good for the education of pre-service teachers as well. Accordingly, it is important for curricula in colleges of education to provide pre-service teachers with educational experience through which they may reflect on their own teaching competencies and develop their level of professionalism.

Previous studies focused on teachers (Cook, 1996; Dieker & Monda-Amaya, 1995; Fetting, 1999; Sparks-Langer & Colton, 1991) have

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suggested positive results in the development of reflective thinking ability, which has been shown to lead teachers to reasonably solve various problems in the educational field, improve their teaching competencies, and increase their confidence in teaching. Studies focused on pre-service teachers (Norton, 1997; Pugach, 1990) have also reported that pre-service teachers' teaching competencies improved along with the advancement of reflective thinking. Therefore, it is important to offer an educational experience that provides pre-service teachers with the opportunity for reflective thinking.

Reflective thinking is defined as the thinking that is developed by reflecting on self or functions of the self (Seoul National University Educational Research Institute, 1994). In particular, Dewey (1933) explained that reflective thinking is an active consideration of the grounds for or eventual outcomes of one's belief or practical actions. To science teachers, reflective thinking can be viewed as the process of recognizing the problems involved in the setting of science classes and consider new alternatives to resolve them. From this point of view, National Science Education Standards (NRC, 1996) is listed as the ability of science teachers for reflective thinking. In other words, the teachers can explore alternatives and thereby lead qualitative educational changes through reflective thinking. Thus, the analysis on the reflective thinking of would-be science teachers on the classes they conducted may suggest the implications for their future teaching activities.

In this sense, it is expected that many implications will be drawn from the analysis of pre-service teachers' reflective thinking using microteaching, which is a technique for enhancing their teaching competencies. Traditionally, microteaching has been used as a method of analyzing pre-service and in-service teachers' classes and developing their teaching techniques. Many studies of microteaching among pre-service teachers have been

conducted from this perspective (Amobi & Irwin, 2009; Fernandez, 2010; Fernandez & Robinson, 2006; Funmi, 2005; Mergler & Tangen, 2010; Oliver, 1993). In contrast, similar studies have rarely been done in the Korean science educational world. A previous study focusing on pre-service science teachers (Son *et al.*, 2007), in particular, was limited to analysis of the subjects' ability to apply a teaching model. However, a microteaching model is also effective in examining pre-service teachers' reflective thinking because it combines peer assessment, self-assessment, and teacher assessment, allowing a second lesson that reflects the assessment results. Nonetheless, qualitative studies of how pre-service science teachers' thinking process changes through the educational experience, namely microteaching, have rarely been conducted. Thus, this study aims to analyze how pre-service science teachers' reflective thinking is presented during the microteaching process.

Teachers' pedagogical knowledge is reconstructed when they talk about their actual teaching experience (Connelly & Clandinin, 1988). Accordingly, a narrative inquiry is a very useful method of examining the reflective thinking that takes place within educational practice. A narrative is a description of a certain life in the form of a story. It arranges events, characters, and scenes in a temporal manner, while revealing the meanings of its causal relationships (Carter, 1993). The unique characteristic of such a narrative approach is that it leads pre-service teachers to describe the microteaching process that they have personally experienced, enabling an understanding of their perceptions and thinking processes. Merseth (1996), in particular, argued that pre-service teachers' reflective thinking levels improved when they were instructed to write a journal of their teaching performance. This shows that a narrative inquiry can be effectively utilized for analysis of pre-service teachers' reflective thinking. In this research, the teachers were

directed to record anecdotes about their microteaching experience, as their underlying beliefs, emotions, and assumptions can be inferred from such anecdotes (Mattingly, 1991). Moreover, a study of research programs for science teachers (Bell & Gilbert, 1996) reported teachers' view that sharing their anecdotes about science classes with one another was the most valuable part of the training content. Thus, this study aims to analyze narratives representing pre-service teachers' reflective thinking about teaching performance during the microteaching process. This analysis will provide data that help to elucidate pre-service teachers' reflective thinking.

II. Methods

1. Subjects

The subjects of this study were 13 students who attended a lecture course on science teaching methods offered by the Department of Science Education of the College of Education at a national university. They all were juniors who had taken courses in the theory of science education, theory of inquiry learning, and the science curriculum and its assessment. In particular, it can be considered that there was rapport established between this researcher and the subjects, as they had taken his lectures before this is why junior students who had taken these lectures were selected as the subjects. The participants were informed in detail of the purpose and methods of this study, and their consent was provided.

2. Instructional procedures

For the first three weeks of the course, the professor explained theories of microteaching and introduced examples. Each simulated lesson was videotaped for about 15 minutes. The simulated lessons that were performed during the microteaching process went through peer

assessment and self-assessment. Then, the next set of lessons was conducted based on the assessment results. After the first simulated lessons, all of the pre-service teachers described their opinions about their lessons in an open questionnaire. Peer assessment was conducted at the same time, and the results were given to each presenter. The second set of lessons was performed after a week, and another open questionnaire was filled out after these lessons. After the first and second simulated lessons, the videotaped parts were transcribed, and the problems pointed out in the assessment were examined.

3. Data collection

The open questionnaires filled out after the first simulated lessons were collected. In the self-assessment form, pre-service teachers were instructed to freely describe their reflective thinking, feelings, and opinions about the lessons in any form and at any length. The results of the peer assessment after the first simulated lessons were given to the pre-service teacher who conducted the respective lesson. The second lessons were performed after revising the method and contents of the lesson based on the assessment results. After the second lessons, the open questionnaires were again completed and collected.

4. Data analysis

In this study, the reflection rubric developed by Ward *et al.* (2004) was modified for improvement and used as the analytical framework for reflective thinking. According to this framework, reflective thinking was divided into four levels for analysis: routine, technical, dialogic, and transformative. Three dimensions were added focus, inquiry, and change in which reflective thinking may occur when pre-service teachers perform microteaching lessons, in particular, and a two-dimensional analytical framework

was utilized. This framework is illustrated in table 1. The “focus” dimension represents the focus of concerns about teaching practice, while “inquiry” is the dimension involving why such teaching practice is performed. Finally, “change” is the dimension representing how inquiry about teaching practice changes teachers’ practice and perspectives. In each dimension, reflective thinking means that more long-term and continual inquiries are made with a focus on a wider range as the level changes from “routine” to “transformative,” thereby causing fundamental change in teachers’ practice and perspectives. As such, the level of reflective thinking among pre-service teachers in each dimension during microteaching can be identified by using a two-dimensional analytical framework.

The responses written in the assessment forms were first extracted according to conceptual unit of reflective thinking. A conceptual unit is a sentence or paragraph that presents reflective thinking in terms of certain themes or events related to microteaching lessons. Accordingly, the extraction of reflective thinking by conceptual unit was carried out from the self-assessment forms completed after the first and second simulated lessons. The extracted

conceptual units were classified into the three dimensions of focus, inquiry, and change, and the level of each unit in each dimension was determined. To verify the validity of the results of the analysis, the researcher’s two analyses and two science education specialists’ analyses were compared to ascertain the level of agreement. Interpretation results that did not correspond to each other were reviewed through repetitive analyses and discussions until the discrepancy was remedied.

III. Results and discussion

1. The self-assessment results after the first simulated lessons

The results of analyses of pre-service teachers’ reflective thinking based on the self-assessment forms after the first simulated lessons using microteaching revealed that reflective thinking at the routine and technical levels was most remarkable in the focus dimension. Moreover, technical reflection stood out in the inquiry and change dimensions. Of particular note was that the dialogic and transformative levels of reflective thinking hardly occurred. The results of analysis of the

Table 1
Analysis framework

	Routine	Technical	Dialogic	Transformative
Focus	<ul style="list-style-type: none"> • I concentrate on the egocentric theme. 	<ul style="list-style-type: none"> • I concentrate on the specific activity of teaching.(ex: the plan of class etc) 	<ul style="list-style-type: none"> • I pay attention to the student and have the concern in the interaction of the students. 	<ul style="list-style-type: none"> • I have the concern in the professional about the activity of teaching, historical, and ethical view.
Inquiry	<ul style="list-style-type: none"> • I do restrictive and general analysis. 	<ul style="list-style-type: none"> • I inquire into oneself about the specific situation but don't mention repeatedly. 	<ul style="list-style-type: none"> • I consider the others's point of view including the question, students and colleague based on the open-ended thinking. 	<ul style="list-style-type: none"> • I consider about the activity of teaching alertly.
Change	<ul style="list-style-type: none"> • There is no individual reaction, I analyze about doing itself. 	<ul style="list-style-type: none"> • In order to change view, I don't use the situation. 	<ul style="list-style-type: none"> • I integrate the question in order to develop the new perception. 	<ul style="list-style-type: none"> • I restructure about the view leading the basic change of doing.

pre-service teachers' responses are shown in table 2. A routine level means that the focus of reflective thinking about science teaching remains in self-centered thinking, such as student management and control. Thus, it can be interpreted that this level of reflective thinking has very limited effects in bringing about change in pre-service teachers' teaching practice or perspectives.

The analysis of reflective thinking in the inquiry dimension also indicated that reflective thinking at the dialogic and transformative levels is extremely limited. That transformative reflective thinking did not occur in the inquiry dimension means that the pre-service teachers did not carefully reflect on their teaching practice during the microteaching course. This suggests that pre-service teachers need to be provided with more educational experience that can promote reflective thinking. In particular,

they should be clearly informed that the aim of microteaching is not to videotape their lessons and re-watch their teaching techniques.

Most of the pre-service teachers presented routine and technical reflective thinking in the change dimension, while not presenting dialogic or transformative reflective thinking at all. That reflective thinking did not occur at various levels in the change dimension indicates that the pre-service teachers' reflection was insufficient to cause fundamental change in their teaching practice. This also means that partial change may have been brought about in their teaching practice, but a new level of reflection on teachers' perspectives was not induced. This result corresponds to that of a study (Chung *et al.*, 2007) indicating that pre-service teachers' reflective thinking is largely limited to teaching content and techniques.

Table 2
The first results of self-assessment

	Focus				Inquiry				Change			
	Ro	Te	Di	Tr	Ro	Te	Di	Tr	Ro	Te	Di	Tr
1. Soojung		■			■				■			
2. Jihyun		■				■			■			
3. Dakyung	■				■					■		
4. Chulmin		■				■				■		
5. Donghyun		■				■				■		
6. Minsoo	■					■				■		
7. Taemin	■					■			■			
8. Sungwon		■	■			■				■		
9. Youngsoo	■					■						■
10. Jinhyuk		■					■			■		
11. Sangjin		■	■			■				■		
12. Dongjin	■					■			■			
13. Chohee	■					■			■	■		
	6	7	2	0	2	10	1	0	5	8	1	0

* The names of the participants are pseudonyms.
* Ro: Routine, Te: Technical, Di: Dialogic, Tr: Transformative

I was sorry that I did not do the teaching very well once I actually had to do it even though I had done a great deal of preparation to arouse students' interest. I think I talked faster than usual probably because I was nervous. I know I could have done better. I will try harder not to make mistakes next time. (Minsoo)

There was one case in which a pre-service teacher created situation-related inquiries in reflective thinking about his or her own lessons. Although this did not lead to a changed perspective, a different situation was employed in generating inquiries.

It was easy to concentrate on the lesson since advertisements and movie scenes were used. I think it would be good if such materials could be utilized in actual schools. (Sungwon)

According to an examination of the pre-service teachers' responses, it was found the scope of their reflective thinking was limited mostly to teaching techniques and strategies. In contrast, elements representing educational philosophies or values were not presented. This result corresponds to that of a previous study (Chung *et al.*, 2007). In addition, reflective thinking did not occur in relation to the teaching content, assessment of interactions with students, or review of educational philosophies.

I think that there is a need for an proper speed of explanation and accurate pronunciation. It seemed that the teacher's inappropriate language behavior led to a loss of students' interest. I will fully prepare myself so that lessons can be smoothly conducted. Although I tried to give explanations in relation to our real life, it did not work out well. I think I need to have a suitable level of vocabulary for students. (Dongjin)

That the pre-service teachers' reflection was mostly at the routine and technical levels

indicates that reflective thinking cannot be achieved in a short period of time. In other words, it suggests that pre-service teachers need to be consistently provided with education about and training in reflective thinking. Curricula for colleges of education, in particular, should offer the opportunity for reflection to pre-service teachers by including courses in pedagogy and subject matter pedagogy, as well as providing sufficient feedback.

The distinguishing aspect of the pre-service teachers' responses was that the levels of reflective thinking occurring in each dimension tended to mingle. Of course, the mingling patterns were not consistent, but in most cases, the level of reflective thinking varied in each of the three dimensions. In some cases, the levels were routine-technical-routine or technical-routine-routine. In other cases, the levels were dialogic-routine-routine or technical-dialogic-routine. This clearly shows that the pre-service teachers' reflection did not occur at the same level in the focus, inquiry, and change dimensions. The mingling patterns of reflection levels according to dimension are illustrated in table 3.

As shown in Table 3, although some of the pre-service teachers presented the same level of reflective thinking in the three dimensions of focus, inquiry, and change, the majority displayed mingled levels of reflection. This suggests that pre-service teachers do not possess or think based on an understanding of the correlations between the three dimensions of reflective thinking. Thus, it is considered to be crucial to lead them to experience the continuity of reflective thinking through teaching-learning activities, so that they can focus on their problems and understand causes and processes related to these issues, thereby bringing about ultimate change.

2. The self-assessment results after the second set of lessons

The second set of lessons was conducted after

Table 3
The changes of reflective thinking level

Type	Contents	Frequency
A	Ro - Ro - Te	1
B	Ro - Te - Ro	3(C type overlap case: 1)
C	Ro - Te - Te	2
D	Ro - Te - Di	1
E	Te - Ro - Ro	1
F	Te - Te - Ro	1
G	Te - Te - Te	4(I type overlap cases: 2)
H	Te - Di - Te	1
I	Di - Te - Te	2

the pre-service teachers were given the results of the peer assessment. This means that the results of the self-assessment carried out after the second lessons showed the influence of the peer review. This is also considered to have influenced the pre-service teachers' reflective thinking. According to the self-assessment

through open questionnaires after the second lessons, the pre-service teachers' reflective thinking was most active at the technical level in all of the dimensions (table 4). In particular, routine and technical reflection decreased, while dialogic reflection increased. In addition, reflective thinking at the transformative level,

Table 4
The second results of self-assessment

	Focus				Inquiry				Change			
	Ro	Te	Di	Tr	Ro	Te	Di	Tr	Ro	Te	Di	Tr
1. Soojung		■				■				■		
2. Jihyun			■		■	■				■		
3. Dakyung		■				■			■			
4. Chulmin		■					■				■	
5. Donghyun			■			■						■
6. Minsoo		■					■			■		
7. Taemin		■				■			■			
8. Sungwon			■				■					
9. Youngsoo		■	■			■				■		
10. Jinhyuk		■					■	■		■		
11. Sangjin			■			■			■			
12. Dongjin		■	■					■			■	
13. Chohee		■					■	■		■		
Total	0	9	6	0	1	7	5	3	3	6	2	1

which was not displayed in the responses after the first simulated lessons, was present in the responses after the second lessons, though at a low rate. The cause of this change can be interpreted from diverse angles. Firstly, performing two sets of simulated lessons during microteaching may have promoted reflective thinking in the process of pre-service teachers preparing for and carrying out the lessons. In addition, the effect of repetitive surveys on practice may have influenced the process of describing these experiences. What is most important, however, is the influence of the results of the peer assessment of the first simulated lessons.

In the self-assessment after the second set of lessons, in particular, a few of the pre-service teachers presented dialogic reflection by adopting others' perspectives in the focus and inquiry dimensions. This can be understood to indicate that they intimately linked the results of the peer assessment to their own reflective thinking.

The results of analysis of the responses revealed that the second self-assessment presented different dimensions and levels of reflective thinking compared with the previous self-assessment. It can be considered that the increased instances of self-assessment and the results of the peer assessment were influential causes of this. Schön (1987) divided reflection into "reflection-in-action" and "reflection-on-action." The self-assessment in this study can be regarded mostly as "reflection-on-action," since it was carried out after simulated lessons. Thus, an increase in opportunities for reflecting on their lessons may promote reflective thinking. The next issue to be considered has to do with the results of the peer assessment. The pre-service teachers reviewed the results of the peer assessment of their lessons after the first simulated lessons. Therefore, the results of the assessment may have served as an opportunity for recognizing the criticisms of aspects they had not been aware of previously. To determine

whether the results of the peer assessment influenced the pre-service teachers' reflective thinking, the results of the assessment of each pre-service teacher were analyzed. Table 5 shows the points that are repeatedly criticized in the peer assessment.

The pre-service teachers' second self-assessment reveals that the points criticized in the peer assessment influenced the teachers' reflective thinking. In particular, reflective thinking that was not presented in the self-assessment after the first simulated lessons was promoted by the peer assessment.

I think appropriate language habits are the priority required to become a good teacher. During the lesson, I had to pay attention to many things such as speech speed, intonation, and vocabulary. Above all, students' attention to what the teacher says is required for them to have interest in the lesson content. (Jihyun)

It seemed effective to ask them questions in the form of a TV quiz program. I think it is a good idea to utilize this method to arouse students' interest and attract their attention. I will make further efforts to apply various teaching methods in addition to this method of asking questions. (Donghyun)

During the microteaching course, I was asked what the goal of my lesson was. There should be various types of lessons, such as a fun lesson, a lesson with faithful explanations, etc. I could not reflect on how and what I should teach at all because I was engaged in conveying the teaching content within a given time. (Youngsoo)

As the above responses show, in the second self-assessment, some pre-service teachers, though very few, presented dialogic and transformative levels of reflection in each dimension. This suggests the possibility of change compared with the first self-assessment.

Changes from the first assessment were detected in the three dimensions of focus, inquiry, and change. This result shows that the adoption of peer assessment may be an effective method of promoting pre-service teachers' reflective thinking. In some cases, reflective perspectives that were not displayed in the self-assessment were presented in the peer assessment. The

effectiveness of peer assessment in promoting reflective thinking was reported in a study by Carr and Biddlecomb (1998), who claimed that students are better at criticizing others' activities than they are their own. Thus, there is a need for analysis of the effects of peer assessment on pre-service teachers' reflective thinking during various teaching activities.

Table 5
The results of peer-assessment

	strength	weakness
Soojung	<ul style="list-style-type: none"> • This lesson using computer program was effective. • The explanation used the map was good. 	<ul style="list-style-type: none"> • The goal of lesson was not clear. • The lesson was so rapidly progressed. • The arrangement of concept was not systematic.
Jihyun	<ul style="list-style-type: none"> • The speed of class progression was appropriate. • The materials for teaching were very well. • The vocabularies of pre-service teacher were so difficult. 	<ul style="list-style-type: none"> • The lesson organization was so tedious and the interest induction was difficult. • There was nearly no interaction among teacher and students.
Dakyung	<ul style="list-style-type: none"> • It was the lesson inducing the participation of the students. • The real life-related example was much presented and the understanding was easy. 	<ul style="list-style-type: none"> • The speed of speaking sucked so and the concentration was obstructed. • Using the Powerpoint was not effective.
Chulmin	<ul style="list-style-type: none"> • The concentration was well induced to the unique intonation and expression. • The understanding level of the student was confirmed by the question. 	<ul style="list-style-type: none"> • It concentrated so on the interest induction and the concept explanation was unable to be smooth. • Visual materials were so much presented and the class was in confusion.
Donghyun	<ul style="list-style-type: none"> • The audiovisual material was well utilized and it was the interesting lesson. • The visual contact among teacher and students was well made. • The self-confidence of teacher was sufficient. 	<ul style="list-style-type: none"> • The learning material and content was unable systematically to be suggested. • The video viewing time was so long and the lesson concentration reduced.
Minsoo	<ul style="list-style-type: none"> • The photo was utilized for easy illustration. • The interest of the students was well induced. 	<ul style="list-style-type: none"> • The teacher seemed to don't have the self confidence about its own lesson. • The voice was so quiet and it was a little tedious.
Taemin	<ul style="list-style-type: none"> • The spoken speed and voice was suitable for the science instruction. • The lesson management ability of teacher was good. 	<ul style="list-style-type: none"> • There was no concrete example and it was difficult to understand the science concept. • It was the lesson without the students' participation.
Sungwon	<ul style="list-style-type: none"> • The interest of student was brought by using animation. • Teacher illustrated concept easily. So we understood very well. 	<ul style="list-style-type: none"> • The feedback about the question of the student was not suitable. • There was lots of the operation which scatters the concentration such as touching the head repeatedly, etc.

Youngsoo	<ul style="list-style-type: none"> • The real life examples were effective. • Using of Powerpoint was appropriate. 	<ul style="list-style-type: none"> • The interaction with the students was not well comprised. • The teacher was unable to grasp completely about its own lesson.
Jinhyuk	<ul style="list-style-type: none"> • Teacher induced the participation of the students in the science class. • The understanding level of student was frequently checked. 	<ul style="list-style-type: none"> • The teacher was embarrassed by the question of the student. • The arrangement of content was unable to be systematic and rather it was confused.
Sangjin	<ul style="list-style-type: none"> • The preparation of teaching material was well made. • The activity of class was impressive. 	<ul style="list-style-type: none"> • Many data were arranged and the cathexis was in trouble. • It was the interesting lesson but it got distracted.
Dongjin	<ul style="list-style-type: none"> • The lesson speed was appropriate and the understanding went well. • The organization between contents was well made. 	<ul style="list-style-type: none"> • The interest induction was insufficient. • It was tedious because of being the explanation-centered lesson.
Chohee	<ul style="list-style-type: none"> • The visual material was well utilized. • Interesting image data were presented. • Teacher and students interacted actively. 	<ul style="list-style-type: none"> • The answer about the question was not clear. • The misconception is likely to be generated because of giving the inappropriate example.

It was difficult to settle questions regarding in what order teaching materials should be presented in planning the lesson and whether the lesson can be understood at the learners' level. Especially, I think that there may be some difficulties in terms of learning sequence and prior learning because the students learn about various matters in a limited time. (Chohee)

Considering environmental education important, I gave a lesson about the environment. However, once I began the lesson, I came to wonder whether this theme would arouse the students' interest because something important and something interesting may be different. In future lessons as well, there will be discordance between teachers' and students' thoughts. I think I have to contemplate this matter. I tried to use video materials that I had found for the lesson, but some of them lacked reliability. However, I cannot even conceive the idea of creating all materials by myself. I realized that making good use of proper materials is one of the important abilities required of a teacher. (Jinhyuk)

Prasart (2009) emphasized that pre-service science teachers may change the paradigm of "teaching" by applying what they have learned to actual situations. According to the results of this study, microteaching is significant in that it allows experience of various aspects of teaching activities, although it is not a teaching activity aimed at actual middle and high school students. Moreover, peer and self-assessment through microteaching lessons is considered effective in promoting pre-service teachers' reflective thinking. Therefore, it is not appropriate to put the focus of microteaching merely on training in the teaching techniques of in-service or pre-service teachers. The microteaching techniques need to be systematized so that this approach may contribute to the enrichment of a paradigm of teacher training.

IV. Conclusion and implication

The purpose of this study was to analyze pre-service science teachers' reflective thinking is presented during the microteaching process. After the first set of simulated lessons, the pre-service teachers' reflection at the routine and

technical levels was most remarkable in the focus dimension. In the inquiry and change dimensions, technical reflection stood out. Dialogic or transformative reflection was rarely presented. In addition, most of the pre-service teachers displayed mingling patterns of reflection levels in all of the three dimensions. This indicates that they did not properly perceive the correlations between each element of reflective thinking. Thus, it is considered crucial to lead them to experience the continuity of reflective thinking through teaching-learning activities so that they can focus on problems and understand their causes and processes, thereby ultimately bringing about change.

The second self-assessment exhibited changes in the dimensions and levels of the pre-service teachers' reflective thinking compared with the previous self-assessment. It can be considered that the increased instances of self-assessment and the results of the peer assessment were reflected in this development. This suggests that the active adoption of peer assessment may be effective in promoting pre-service teachers' reflective thinking.

The microteaching technique is significant in that it provides teachers with the opportunity to reflect on their own lessons. This model has been frequently utilized to analyze lessons and improve teaching techniques. The results of this study, in particular, prove that microteaching has a high level of applicability in terms of reflective thinking and instructional technology. Accordingly, there is a need for subsequent studies to create a new model that can encourage pre-service teachers' reflective thinking by structuralizing peer and self-assessment during the process of microteaching.

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