A Trajectory of a Teacher's Professional Growth: An Analysis of Revoicing in a Preservice Mathematics Teacher's Classroom Discourse

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ABSTRACT

This research analysed classroom discourse of a preservice mathematics teacher, Dayoung, to investigate the functions of teacher's revoicing and the change in her use of revoicing to describe the features of its effective use in the context of teaching mathematics. The data for this research had been collected in the context of teaching practicum program which was designed to provide preservice teachers with an environment for learning-to-teach through reflective practice. The analysis identified diverse functions of teacher's revoicing including highlighting emerging mathematical positions, making a connection among students' mathematical ideas, initiating and sustaining a student's mathematical argumentation. The comparative analysis showed that Dayoung's use of revoicing has changed over the practicum. Specifically, in the first semester of the practicum, Dayoung's use of revoicing was isolated from the students' argumentation. On the contrary, in the last semester of her practicum, her use of revoicing was well integrated into the on-going mathematical arguments in class to guide the students to construct collaboratively mathematics. This research suggests that analysis of a teacher's classroom discourse provides useful information for understanding teacher's professional development. Also, further research is needed to investigate how to organize teaching practicum to support the development of teacher's competence of teaching mathematics in class.

Key words: revoicing, teacher discourse, discursive competence,

professional development

I. INTRODUCTION

Since the 1980s, community of mathematics education has adapted theoretical discourses that conceptualize mathematics classroom as a community of mathematics and teaching and learning of mathematics as the engagement with mathematics. This conceptualization of teaching and learning mathematics has its origin in the idea that mathematics is human conduct situated within the cultural organization of communal practice. As communal practice, mathematics includes a set of facts and skills but also a certain cultural values and norms of conducts such as thinking, seeing, talking about mathematics. This suggests that teaching and learning mathematics goes beyond dealing with a collection of facts and skills. Since mathematical facts, skills and activities are cultural constructs of mathematics community, teaching and learning mathematics is also concerned with active participation into activities such as problem solving, conjecturing, inventing, providing a convincing argument and justification. The participation is situated within the norms and values of how to practice mathematics. Therefore, in this perspective, recent reform documents recommend that teachers are encouraged to create a classroom as a community where students can engage with mathematics to gain facility for thinking, seeing, talking, and doing mathematics in legitimate ways, and ultimately to guide a student's social transformation as a practitioner of mathematics.

Then, how can teachers accomplish these goals in teaching mathematics? This research accommodates the sociolinguistic assumption that teacher discourse works as a medium to create a cultural context for the practice of mathematics in class. In other words, through verbal interaction with students, mathematics teachers engage in a form of language socialization that brings students into certain ways of talking and thinking (Hicks, 1996; O'Connor & Michaels, 1993). From this perspective, teachers' role in discourse is proposed as one of professional

standards for mathematics teaching (NCTM, 1991). Teacher educators are urged to equip mathematics teachers with discursive competence that is necessary to play a proactive role in order to facilitate and orchestrate classroom practice of mathematics. In this context, this research investigates classroom discourse of a preservice mathematics teacher, Dayoung , focusing on her use of revoicing in the context of teaching practicum for three semesters. Specifically, the analysis focused on the functions of revoicing and the change in the use of revoicing over teaching practicum to describe the features of effective use of revoicing.

II. THEORETICAL BACKGROUNDS

A. Educational Significance of Teacher Discourse

The emphasis on a mathematics teacher's discourse role is predicated upon the ideas that mathematics is the social practice of a mathematics community and that discourse is the essential part of the social practice of mathematics (Cobb & Bauersfeld, 1995; Forman, Larreamendy-Joerns, Stein, & Brown, 1998; Lampert & Blunk, 1998). As social practice, mathematics is conceptualized as a historicocultural construct produced by a practice community based on its shared cultural values and norms of how to practice mathematics. Therefore, teaching and learning of mathematics is, at a fundamental level, involved with the reformulation of a learner into a cultural being with a certain kind of cultural competences legitimated by the values and norms shared in a community of mathematics. In this perspective, an educational significance of mathematical discourse resides in the fact that discourse is one of cultural media which embeds the cultural values and norms of doing mathematics. In particular, patterns of reasoning, justification, making a conjecture, giving a comment, are made public through a teacher's discourse to provide students with a cultural model of how to do mathematics. Thus, through recurring co-engagement through mathematical discourse, a teacher can frame students'

practice of mathematics according to the cultural values and norms of the mathematics community and facilitate the transformation of a student's ways of thinking (Forman, et als, 1998; Hicks, 1996; O'Connor & Michaels, 1993).

In addition, when considering mathematics as social practice, an individual's practice of mathematics is always revalorized in the context of the communal practice. In other words, an individual's practice of mathematics becomes assigned to a certain position with respect to the culturally shared notion of legitimacy of how to do mathematics. In mathematics classroom, a mathematics teacher plays a role to position individual students' practice of mathematics by deciding what kind of question needs to be raised to whom, whose argument deserves to be referred to for an extended inquiry, and so on. In this regard, teacher's discourse can be considered as an epistemic device. An epistemic device is defined as the means whereby actors or institutions establish and negotiate the legitimacy of knowledge and of knowledge production (Moore & Maton, 2001). Teacher's discourse as an epistemic device functions to shape the practice of mathematics in class by distributing the norms of doing mathematics and establishing power relations according to the norms. In the power relations, a student becomes to have a certain position at which s/he develops a view of mathematics and an identity as a learner of mathematics. So teacher's discursive competence is critical to create a learning environment where students are positioned as authors of mathematics and as arbiters of what counts as truth in the classroom practice of mathematics.

In this regard, a teacher's discourse can be considered as deliberate actions taken by a teacher to mediate, participate in, or influence the practice of mathematics in class (Krussel, Edwards, & Springer, 2004). As a deliberate action, Krussel and her colleagues (2004) argue that a teacher's discourse move is a synthesis of purposes, settings, forms, and consequences. For instance, a teacher's discourse has an intentional purpose such as building norms for classroom practice of mathematics, forming the participation structure in the discourse, or creating or

eliminating disequilibrium. When taking discursive actions, a teacher need to take into account both physical and temporal settings such as physical layout of classroom, established or intended sociomathematical norms. There are various forms of discourse moves (e.g., discourse moves for challenging, probing, or requesting clarification, elaboration, justification, or participation, inviting students' attention) among which a teacher selects. Finally, a teacher's discourse moves result in a certain consequence (e.g., shifting in the cognitive level of a mathematical task, in the discursive focus, or in students' affective attitudes toward mathematics). This synthetic feature of a teacher's discourse move suggests that a teacher's discourse is the culmination of a teacher's professional decision making in a dynamic context of teaching in class. In other words, teacher's classroom discourse can be analyzed as an indicator of professional teaching. From this perspective, this research investigated a preservice teacher's mathematical discourse moves in the context of teaching practicum. The analysis particularly focused on what is the function of revoicing and how the use of revoicing changed over the period of practicum to describe the trajectory of a preservice mathematics teacher's professional growth based on the comparison of revoicing use.

B. Revoicing as an Indicator of a Teacher's Professional Growth

Recently, as reform documents adapt the constructivist perspectives on teaching and learning of mathematics, there has been increasing interest in teacher's roles in discourse. So, for instance, reform documents recommend that mathematics teachers guide students' mathematical inquiries based on their own cognitive resources by raising challenging questions, telling mathematical information in a way tangential to students' meaning system, and listening actively to students' mathematical voices. In addition to questioning, telling, and listening, revoicing is one of major teacher discursive strategies that occur repeatedly in mathematics class. Revoicing is discourse of reuttering another person's speech through simple repetition, rephrasing, expansion,

and reporting (Forman, et al., 1998; O'Connor & Michaels, 1993). Teacher's revoicing is a broad category and carries out a variety of functions in the context of mathematical conversations in class.

In the academic aspect of teaching and learning of mathematics, teacher's revoicing functions to highlight emerging mathematical ideas in class to recruit students' attention. It also functions to align a student with a certain argumentative position to juxtapose diverse mathematical positions. In this way, a teacher can create a participant framework to initiate and sustain mathematical arguments among students. All these functions of revoicing are ultimately concerned with facilitating the negotiation of mathematical meanings among students in order to extend their mathematical perspectives and to guide students to actively participate into the collective construction of mathematics in class (Enyedy, Rubel, Castell?n, Mukhopadhyay, Esmonde, & Secada, 2008; Forman & Ansell, 2002; Forman, et al., 1998; Kwon, Ju, Rasmussen, Marrongelle, Park, Cho, Park & Park, 2008). This suggests that revoicing is a useful discursive strategy for constructivist teaching of mathematics.

In addition to the academic aspect of teaching and learning mathematics, teacher's revoicing is concerned with students' socialization to roles and identities in intellectual discourse. In this regard, the major function of revoicing is positioning students with respect to the normative structure of the classroom mathematics practice. A teacher strategically recasts students' narratives to convey his/her meta-message regarding classroom norms and values of how to do mathematics, what should be known, who should talk, what is appropriate to talk and how. So, by revoicing, a teacher positions a student in relation to the classroom practice of mathematics and the student redefines one's identity. In fact, research showed that revoicing is a teacher's discourse move to confer a student's practice of mathematics a legitimacy and help a student see oneself as an active and competent practitioner of mathematics(Kwon, Ju, Rasmussen, Marrongelle, Park, Cho, Park & Park, 2008; O'Connor & Michales, 1993).

Reform movements since the 1980s advocate mathematics

classroom where students play roles as active agents of mathematics practice by initiating, articulating, explaining, justifying, defending, and negotiating their mathematical perspectives for the construction of mathematics through co-engagement with class participants. In that context of co-engagement, teachers are recommended to play roles as facilitators and orchestrators of classroom practice of mathematics. Asdiscussed, teacher's revoicing is consistent to the values and norms about the kinds of classroom practice of mathematics where a student's own mathematical competence and identity are respected. From this perspective, revoicing is considered as the significant discourse strategy of professional mathematics teachers that makes the norms, roles, and identities visible and accessible to students and ultimately contributes to realize the vision of reforms in class. This research takes revoicing as an indicator for teacher's professional development and comparatively analyses a preservice mathematics teacher's use of revoicing during her practicum to investigate how the use of revoicing changes and what the change tells about her professional development.

III. RESEARCH METHODS

A. Setting and Participant

This research has been conducted to investigate the features of a preservice teacher' classroom discourse in the context of teaching practicum. The practicum program of this research had been developed as part of a university-level teacher education program in response to the social expectation of teacher education reform. It had long been pointed out that Korean teacher education was too theoretically oriented to equip preservice teachers with practical knowledge for teaching in school. The Korean ministry of education recommends that university teacher education programs offer more practicum courses for preservice teachers to develop their competence for teaching in school. In this context, the practicum program of this

research was developed as a university-level teacher education course to provide student teachers with field experiences at an early stage of teacher education. In order to support preservice teachers' learning-to-teach, this program had been designed based on the following principles.

First, the program adapted the constructivist views of learning-to-teach. A student teacher's knowledge and beliefs about teaching and learning, whether it was experiential or theoretical, were valued. So a student teacher was encouraged to develop a teaching plan based on his/her own knowledge and beliefs about mathematics. In this regard, the practicum was intended to provide a learning environment where a student teacher testified one's own teaching plan it in the authentic context of teaching. Although a student teacher was encouraged to accommodate comments given by their colleagues and supervisors, his/her decision was always respected.

Second, this program was to provide a collaborative network to support a student teacher's learning-to-teach by providing opportunities to interact with different kind of experts on mathematics teaching including their peer student teachers, coordinating teachers in school, and the university supervisor. Student teachers worked in a group of 3 or 4 to teach a class. They were encouraged to collaborate to prepare for teaching a class. When a student teacher was teaching a class, colleague student teachers observed the class. The university supervisor and collaborating teachers circulated to observe every class taught by student teachers and gave comments after class or in weekly conferences. This collaborative network provided students teachers with opportunities to encounter different methods and perspectives of teaching mathematics to broaden their repertoire of pedagogical knowledge.

Third, the program was to help student teachers to close the gap between theory and practice of teaching by providing a context for learning-to-teach through reflective practice. In order to facilitate reflection, student teachers were required to keep weekly journals about their teaching. Weekly conferences were held for student teachers to share and to reflect upon their

experience in class. At the end of a semester, student teachers handed in their teaching portfolio that included essays about their views of teaching and an analysis of a sample class.

This research focuses on the case of a preservice mathematics teacher, Dayoung. Dayoung had been chosen as a case since she had participated in the program for three semesters so that there were collected an abundant amount of data for the inquiry of her professional growth. In teaching mathematics, Dayoung adapted the social constructivist perspective so that she encouraged the students' active participation into mathematical inquiry to learn mathematics. For the purpose, Dayoung's class was organized around problem solving. The tasks for problem solving activities included a sequence of questions to guide the collaborative construction of mathematics out of real world phenomena. The tasks also included questions to facilitate students' explanation and justification of their mathematical findings. Furthermore, Dayoung's class entailed three sequential segments to effectively facilitate students' mathematical inquiry and communication. In the first segment, Dayoung introduced a task to the students. Then, the students worked on the task collaboratively in small groups of 3-4, which constitutes the second segment of class. While the students discussed on the task in small groups, Dayoung circulated around the class to prompt the students to approach a task by a variety of strategies and to further their mathematical inquiry. Whole class discussion followed small group discussion. In this final segment of class, Dayoung played a role as a facilitator and orchestrator of the whole class discussion. She encouraged the students' participation through presenting, explaining, justifying their own mathematical ideas, and asking questions and giving comments to one another.

In general, the practicum program worked as an arena for Dayoung to experiment her own notion of "good mathematics teaching," that is, a social constructivist approach to learning mathematics based on inquiry and communication. She developed teaching plans and materials by herself and applied in her class. As planning her teaching, Dayoung tried to adapt

theories about teaching and learning of mathematics that she had encountered in the university courses concerning mathematics education. In practicum, Dayoung practiced her teaching plan and reflected how her teaching turned out in real class context. Teacher's role in discourse was one of major issues in Dayoung's reflection journals. So this research analysed the change of Dayoung's role in discourse, particularly focusing on her use of revoicing in the context of teaching mathematics.

B. Data Collection and Data Analysis

Data for this research had been collected for 3 semesters: from Fall 2005 through Fall 2006. All the class sessions taught by Dayoung were observed and video-recorded. The video-recordings of her teaching were transcribed for discourse analysis. In addition to video recordings, documents made by Dayoung -- including reflection journals, teaching plans, worksheets, and portfolio -- were collected. Interview with Dayoung was conducted after she completed her practicum in order to inquire her experience in the practicum and the effects of the program on her professional development. The interview was audio-recorded and transcribed. The documents and the interview transcripts were used to validate and supplement the analysis of her classroom discourse.

Through the practicum, Dayoung had taught 4 sessions during the first semester, 3 sessions during the second semester, and 7 sessions during the last semester. Because of the quality of recording, only 2 sessions of the first semester could be fully transcribed. Also, during the last semester, Dayoung taught class as a substitute for 3 sessions. She wrote about the hardship of teaching as a substitute in her reflection journal, those 3 sessions were excluded from the analysis. All the 9 transcripts were used for the qualitative discourse analysis. For quantitative analysis, transcripts of 6 class sessions (2 classes per semester) were selected in order to balance data size per semester. One of the sessions from the first semester was chosen because it was Dayoung's first teaching in the practicum. Likewise, one of the sessions from the last semester was selected because it was

Dayoung's last teaching in the practicum.

As mentioned, each class session consisted of three sequential segments: introduction, small group discussion, and whole group discussion. The analysis focused on the third segment of Dayoung's class where she consciously played her role in discourse role as a teacher. The preliminary analysis of the transcripts focused on the identification of discourse types that occurred in Dayoung's classroom discourses. Each of the class transcripts was uploaded into an Excel spreadsheet. All the utterances by the teacher and the students were separated sentence by sentence and placed on individual cells of the spreadsheet. After sorting the utterances by the form of a sentence, the functional aspects of utterances were taken into account. When a subsequent utterance carried out an identical function or content from the previous one, the two sentences were placed on the same cell and treated as one unit for analysis.

A coding scheme was primarily developed based on literature review and then refined through multiple passes through the classroom discourse data. In the analysis, both form and function of teacher discourse were considered and as a consequence, 4 types of the teacher's discourse moves were identified: questioning (Q), telling (T), managing (M), and revoicing (R). Questioning is a discourse move that Dayoung checked for students' understanding, or requested students' explanation, justification, and so on. Most of questioning occurred in the form of interrogative sentences. However, the essential feature of questioning is concerned with whether a given utterance functioned to request for the students to accomplish a certain type of mathematical reasoning. Thus, questioning is defined as an utterance that functioned to request a student to clarify, explain, justify one's own mathematical ideas. Telling is a discourse move in which Dayoung stated mathematical facts or procedures, explains or evaluates students' mathematical arguments, answers students' questions, and so on. Managing is a discourse move in which Dayoung directed or arranged students' learning in her class. Revoicing is a discourse

move in which Dayoung reuttered students' mathematical utterance.

Each of the four categories was refined further into subcategories. In particular, consistent with Forman et al. (1998), it was observed that Dayoung's use of revoicing occurred in distinguished ways such as repetition, rephrasing, expansion, and reporting. Repetition (R1) occurs when Dayoung repeated a student's utterance using the same words or a portion thereof. In rephrasing (R2), Dayoung stated a student's utterance in a new way but does not change its mathematical meaning. Reporting (R4) occurred when Dayoung recasts by referring to a specific student to whom the idea belongs to. Expansion (R3) was distinguished from other types of revoicing in the regard that it was a discursive move to add new information in restating students' arguments. As these descriptions suggest, the four types of revoicing could be distinguished from one another by their functions as well as forms in the context of teaching. After a coding scheme was established, each teacher utterance was assigned a code for discourse move. This was a way to find out whether the developed coding scheme covered all the utterances by Dayoung. Through multiple coding processes evolved the coding scheme.

While revoicing is one of major categories in Dayoung's classroom discourse, it is distinguished from questioning and telling in the fact that it did not occur as an independent discourse. Revoicing most often occurred concomitantly with questioning or telling. Therefore, in the analysis of this study, revoicing is treated as a subcode that follows either the code of questioning or of telling. For instance, if revoicing occurs in a form of repetition in the context of questioning, the utterance is coded as Q-R1. The subcodes for questioning (Q) and telling (T) are not specified in this paper because the focus of analysis is on the use of revoicing.

IV. FINDINGS

A. Quantitative Findings

The analysis of this research began with the quantitative of how frequently Dayoung used revoicing each semester. Table 1 shows the result:

Table 1. Frequency of Revoicing

Semester	Repetition (R1)	Rephrasing (R2)	Expansion (R3)	Reporting (R4)	Total Revoicing
Fall 2005	6.60%	1.89%	0.94%	2.83%	12.26%
Spring 2006	8.22%	4.11%	0.68%	0.68%	13.70%
Fall 2006	13.23%	2.65%	5.29%	6.88%	28.04%

The quantitative analysis shows several patterns and changes in Dayoung's use of revoicing. First of all, Dayoung's use of revoicing significantly increased over the course of her practicum, in particular when comparing the first semester with the third semester. When considering that revoicing is a teacher's discursive strategy to integrate students' mathematical positions into the classroom practice of mathematics, this change suggests that Dayoung's teaching might change to be anchored in the students' own cognitive resource. Second, Dayoung became to use more various types of revoicing in the context of teaching. During the first semester, most of Dayoung's revoicing was repetition. In the third semester, repetition was the revoicing move that Dayoung used most often. However, she introduced other types of revoicing moves, in particular, expansion and reporting. It can be inferred that Dayoung becomes to have broader repertoire of revoicing and to be more proficient in selecting a proper type of revoicing depending on her need in the context of mathematical communication in class. In other words, over the practicum, Dayoung became more effectively to be able to decide and integrate discourse strategy into her teaching to facilitate constructive learning of mathematics.

In this regard, it is important to note that expansion hardly occurred in the early stage of practicum and dramatically increased in the last semester. Expansion is distinguished from other types of revoicing since it is concerned with teacher's

reformulation of a student's mathematical narratives by adding new mathematical information. It requires a teacher's insightful understanding of students' mathematical positions and on-going practice of mathematics in class as well as of mathematics as a discipline. So the occurrence of expansion implies the growth in Dayoung's competence to bridge between a student's practice of mathematics as well as mathematics as a discipline.

In addition to the use of expansion, the use of reporting increased significantly over the practicum. By attributing a mathematical idea to a specific student, reporting is a teacher's discourse strategy to represent mathematics as a subject which originates from students' own practice in class. So reporting is considered to contribute to the development of the authorship and the ownership of mathematics among students (Kwon, et als., 2008). From this perspective, the increased use of reporting in Dayoung's discourse suggests that she presented mathematics as a subject collectively constructed by classroom participants and allowed the students for active agency to the construction of mathematics.

In summary, the results of the quantitative analysis tell that Dayoung became more proficient at revoicing over her participation into the practicum. She became to use in diverse types of revoicing in her teaching. Then, do these findings imply the development of Dayoung's fluency in revoicing, that is, she became able to select proper types of revoicing and to create a classroom community that is consistent to her vision of good teaching. This question needs a qualitative analysis for an in-depth inquiry into Dayoung's use of revoicing in class.

B. Qualitative Findings

The qualitative discourse analysis was conducted to cross-check and to elaborate the findings from the quantitative analysis. Since the quantitative comparison showed a significant change between the first semester and the third semester, the qualitative discourse analysis focused on comparison between Dayoung's revoicing moves of these two semesters. For comparison, this section presents episodes of the first semester

and of the final semester separately. Each episode was selected as a representative case to show the characteristics of Dayoung's didactical use of revoicing in the context of whole class discussions during the corresponding semester.

1. Fall 2005: The First Semester of the Practicum

Dayoung began her teaching practicum during Fall 2005. During that semester, she taught the 8th graders. Two class sessions were selected for analysis. One of the class sessions was Dayoung's first class that she had taught as a student teacher. In the class, the students worked on a task from the probability unit to find all possible choices. During the first class, Dayoung used revoicing only twice. These two revoicing moves appeared in the following episode:

1	Teacher	So what do you notice in this solution?	Q
2	Student A	They chose the cheapest!	A
3	Teacher	Yes. They chose the cheapest.	T-R1
4	Student B	Easy to understand…Their solution is easier to understand than ours.	A
5	Teacher	A tree diagram makes a solution easy to understand	T-R2

Before this episode, a student presented her own group's solution. Her group used a tree diagram to find all the possible food choices, which the student drew on the board. After the presentation, Dayoung asked the students to identify interesting mathematical features of the solution (Line 1). Student A responded by pointing out how the presenter's group made selection of food (Line 2). Student B pointed out the efficiency of the representation (Line 4). Dayoung recast each of the responses by repeating (Line 3) and by rephrasing (Line 5).

In this episode, these revoicing moves functioned to highlight the students' mathematical perspectives. However, the use of revoicing was rather isolated in the sense that they were not followed by Dayoung's discourse moves to enrich the students' mathematical understanding. For instance, after revoicing the students' mathematical contribution, Dayoung could

have raised a follow-up question to ask the students to explain (e.g,, what do you mean by "easier to understand") or to justify (e.g., why do you think that a tree chart makes the solution "easier to understand"?) their claims, which would prompt the students to reflect upon the strength of mathematical representation they used.

The following episode is from another class session that Dayoung taught six weeks later. In this class, the students worked with manipulatives to find out the conditions for those two right triangles to be congruent:

1	Teacher	So what is the commonality of these three cases?	Q
2	Student A	C is a right angle.	A
3	Teacher	She said that C is a right angle.	T-R4
4		Does everyone agree?	Q
5		Then, isn't C a right angle in problem 2?	Q
6	Student B	It looks like a right angle.	A
7	Teacher	Does it look like a right angle?	Q-R1
8		Why do you think so?	Q
9		Although we can check the size of C in problem 2, what is the commonality of these four problems?	Q
10		It is that all of them are right triangles.	T

In this transcript, revoicing occurred twice in Line 3 and Line 7. Both revoicing moves functioned to highlight students' responses to Dayoung's questions. After her revoicing in Line 3, Dayoung invited the peer students' comments on Student A's claim (Line 4). She raised a follow-up question in order to guide the students to see C being a right angle as one of common features (Line 5). After her revoicing in Line 7, she asked the students to justify the claim in Line 6. However, the question did not work successfully to elicit the students' ideas. Then, Dayoung moved back to the original question and wrapped up the discussion by giving the answer. In this regard, it can be said that Dayoung's revoicing was still isolated. However, it is important to note that she tried to expand the students' arguments through revoicing and that this can be considered as

a significant development in her use of revoicing.

The analysis of the two episodes from the first semester of practicum shows that Dayoung's revoicing moves rather left isolated from mathematical communication in her class. Indeed, after Dayoung completed her first class in Fall 2005, she pointed out that her teaching was not well connected to the students' mathematical ideas. Since Dayoung considered the isolation as the weakness of her teaching, she sought for how to improve it. Teacher's role in discourse was one of major themes in her weekly journals:

> "The teacher gave the answers for most of the questions in the worksheet. If the teacher allowed more opportunities for the students to talk, more ideas would have sprung into the discussion" (Reflection journal of September 28, 2005)

> "I'd rather ask questions, when the students could not solve the problem. I did not anticipate that they wouldn't be able to solve the problem. So I told them how to solve it instead of raising questions to think about. I regreted that I explained the problem instead of questioning" (Reflection journal of September 28, 2005)

In these two journal excerpts, Dayoung reflected upon the discourse roles that she and her colleague preservice teacher played in class and offered ideas how to improve discourse moves to encourage students' active participation and inquiry. Based on the results from the qualitative analysis as well as the quantitative analysis, it is hard to assert that Dayoung's revoicing achieved a meaningful development during the first semester. However, in the second episode from Dayoung's class, it seemed that she tried to facilitate and orchestrate the students' mathematical arguments by revoicing their mathematical ideas. Although it did not work out well, this change seems to indicate that Dayoung's discursive competence as a mathematics teacher began to bloom, of which fruit will be described in the following section.

2. Fall 2006: The Third Semester of the Practicum

In the discussion of the quantitative analysis, it has been pointed out that Dayoung's use of revoicing increased significantly and she became to use more diverse types of revoicing during the last semester of the practicum. In particular, the occurrence of expansion and reporting was interpreted as a sign for the development of her discursive competence as a teacher. This section is to provide a description of Dayoung's revoicing moves during the last semester of her practicum. During the third semester, Dayoung taught the 7th graders. The following transcript is from a session for geometry:

1	Teacher	:	What is a circle?	Q
2	Student A	:	Round.	A
3	Teacher	:	Round.	T-R1
4			Any other ideas? More mathematically?	Q
5	Student B	:	360 degrees.	A
6	Teacher	:	360 degrees···	T-R1
7			That means turning around, right?	T-R2
8			How does it turn around?	Q-R2
9	Students	:	A center!	A
10	Teacher	:	A center.	T-R1
11			There is a center.	T-R2
12			And then how would you draw a circle with a compass?	Q
13	Student C	:	An identical length.	A
14	Teacher	:	An identical length.	T-R1
15			So a circle is what you draw with an identical length around one spot.	T-R3

In the above episode, the conversation began with Dayoung's question to ask the students to define a circle. Although the students were familiar with a circle as a shape, they had difficulty in articulating its defining features in mathematical terms. In order to reach to a mathematical definition of a circle, Dayoung raised a sequence of questions which accompanied revoicing. In that sequence, revoicing is not working as an isolated utterance but connected to upcoming mathematical utterances so that her revoicing moves form well-integrated narratives to prompt the students' further

reflection about a circle and eventually to create a connection among the students' mathematical ideas. Specifically, from Line 6 through 8, there occurred three uses of revoicing in a row. The first use of revoicing in Line 6 functioned to highlight Student B's remark on the 360 degreeness of a circle. In Line 7, Dayoung rephrased the student's expression into another comparable one, "turning around." This rephrasing reformulated the student B's static understanding of a circle to a dynamic one that was involved to the action of geometric construction. Then, in Line 8, she asked the students to reflect on another mathematical feature of a circle in relation to the action of "turning around." This question led the students to attend to a center for turning as a critical feature of a circle, which came up in the following student response. Likewise, the three uses of revoicing from Line 10 through 13 form another chunk that makes a connection between the center of a circle and another critical feature, the radius. The question in Line 12 transited the students to the next stage of inquiry into what is a circle. Finally, in Line 15, Dayoung's revoicing completed the definition of a circle by integrating each student's contributions.

In this episode, Dayoung's revoicing was well-integrated with the students' mathematical arguments. By revoicing, Dayoung highlighted the emerging students' mathematical ideas and then guided the students to switch to other mathematical features of a circle. Revoicing made the mathematical connection of this transition explicit. Dayoung could successfully guide the students to the collective construction of the definition of a circle through a sequence of questioning with revocing of the students' mathematical utterances. In her reflection journal, Dayoung mentioned this change as one of the improvement in her classroom discourse:

> "In my teaching, there occurred many utterances that echo students' utterances. This means that I played a role to support my students to think in their own terms and to help them to transit into more mathematical thinking. I began with students' own way of reasoning and that's the strength of my teaching" (Portfolio of Fall 2006).

By revoicing, Dayoung highlighted what the students claimed to set up a new departing point for further inquiry. In the previous episode, the inquiry was ended up with a mathematical definition which was collaboratively constructed by the teacher and the students. This suggests that teacher's revoicing functioned to lay a stepping stone to the next step of the students' exploration and eventually lead them to the construction of mathematics. Following episode is a case in which Dayoung used revoicing to collaboratively construct a justification with students:

1	Teacher	:	Why is this an equilateral triangle?	Q
2	Student A	:	I repeated drawing segments of the same length.	A
3	Teacher	:	So this length is the same to this length.	T
4			Wait. Why are these two segments of the same length?	Q
5	Student A	:	Because a circle has the same radius.	A
6	Teacher	:	Because a circle has the same radius.	T-R1
7			Which circle?	Q
8	Student A	:	This circle.	A
9	Teacher	:	This one?	Q-R2
10			So do you mean that this length is equal to this length?	Q
11			How about these?	Q
12			Why do these two have the same length?	Q
13	Student A	:	Centered on here···	A
14	Teacher	:	Which circle do you draw if you construct a circle concerned on here?	Q-R2
15	Student A	:	This circle.	A
16	Teacher	:	Then these two become to have the same length.	T
17			So those have all the same length.	T

Student A had finished constructing an equilateral triangle on the board just before this conversation began. Dayoung asked Student A to justify that the triangle on the board was equilateral (Line 1). Student A justified her initial claim by saying that she repeated drawing segments of the same length. The justification needed to be elaborated because it did not

provide enough warrant for the teacher's question. In Line 3, Dayoung picked up a pair of the sides of the triangle among the three sides to ask the student to provide a warrant for her claim about the congruence of the segments. In Line 5, the student supported her claim by telling a property of a circle. However, she did not clearly mention in which circle the pair of the segments were embedded. In Line 6, Dayoung admitted the student's warrant by revoicing and then requested the student backing the warrant to make up the missing information. From Line 12 through 15, Dayoung guided Student A to justify the congruency of another pair of the sides in the constructed triangle. Then in Line 17, Dayoung wrapped up the conversation by restating Student A's claim in Line 2.

In this episode, in combination with questioning to request a warrant or backing, Dayoung's use of revoicing was initiating the student's justification. In the initiation, Dayoung's revoicing functioned to highlight a claim made by Student A and to post it for requesting a warrant or backing. In this regard, Dayoung's revoicing worked to bridge between a claim given by Student A and its warrant and to situate them in an argumentation system. Generally speaking, Dayoung's revoicing functioned to guide a student to talk mathematics according to the cultural scheme of argumentation. In the transcript, most of Student A's utterance is incomplete and partial. By revoicing, Dayoung kept requesting the student to provide missing information to complete her mathematical narratives. Through this collaborative process, the class achieved the collaborative construction of the justification for a mathematical claim with the student.

V. CONCLUSIONS

The general recommendation of school mathematics reform movements since the 1980s is that the authorship of mathematics should be conferred on students in mathematics class. This suggests that the classroom practice of mathematics should be decentered and each participant should be positioned as a

legitimate center of the mathematics practice in class. This is concerned with the issue of equity in mathematics education that promotes everybody's self-esteem and mathematical growth. Research has shown that teacher's revoicing is useful discursive moves to achieve these goals in mathematics classroom. As discussed, through highlighting and aligning, teacher's revoicing functions to exploit students' own mathematical resources. By juxtaposing diverse mathematical perspectives, teacher's revoicing forms a ground for investigating mathematical connections among those diverse perspectives and ultimately collective construction of mathematics through mathematical meaning negotiation. These functions of revoicing show that teacher's revoicing is an epistemic device to position all participants as legitimate members of a classroom community. As a consequence, students develop the sense of ownership for mathematics and positive attitudes toward mathematics and themselves.

Based on these findings of previous studies, revoicing has been taken as a unit of analysis since it was considered as one of useful discourse strategies for teachers to bring the spirit of current mathematics education reform movement into mathematics classroom. Based on the comparative analysis of Dayoung's revoicing use over the period of practicum, this research sought for features of effective revoicing in the context of teaching mathematics. The analysis has shown diverse functions of revoicing. Dayoung used revoicing to highlight the students' mathematical perspectives so that she could integrate the students' own cognitive resource into her teaching. In addition, by revoicing, she turned the students' attention to an emerging mathematical claim to further their mathematical inquiry. Finally, Dayoung's revoicing was to develop a connection among diverse mathematical claims presented by the students for the collaborative construction of mathematics among the class participants including the teacher.

However, it is important to note that Dayoung was not equipped with fluency in revoicing from the beginning of her practicum. The analysis showed that Dayoung's use of revoicing

was rather isolated in the beginning stage of the practicum. She simply repeated a student's utterance without further development in the context of mathematical argumentation. Over the process of practicum, her revoicing moves became to be well integrated into the entire mathematical discourses in class and effectively exploit the students' mathematical resources. Dayoung's revoicing became to function as an epistemic device to develop and establish the norms of her classroom mathematics practice so that everyone was valued and respected as a legitimate center in the knowledge production in class.

The development of a teacher's discourse competence may not be a natural ramification of teaching practicum. As mentioned, teacher's role in discourse was dealt with as one of prominent issues in Dayoung's reflection journals. This suggests that Dayoung might have consciously invested effort in her role in classroom discourse. So it can be hypothesized that reflection is one of factors to contribute to the development of Dayoung's discursive competence. However, in order to support the development of teacher's discursive competence that are consistent with the vision of school mathematics reforms, further systematic investigations are needed to address the questions on how is the role of reflection integrated into the practicum, what kind of educational issues should be introduced, how explicitly a practicum program place an emphasis on a teacher's role in classroom discourse and in what ways.

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