

SUPPORTING TEACHERS ON DEVELOPING TEACHING NORMS BASED ON CHILDREN'S LEARNING MATHEMATICS

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This study was designed to supporting teachers on developing teaching norms based on classroom-learning community in which students are willing to engage in discourse. A collaborative team consisting of the researcher and four second-grade teachers were set up. The collaborative community intended to generate norms of acceptable or appropriate teaching based on what teachers saw about their students' learning mathematics in classroom. Classroom observations and routine meetings were the major data collected in the study. Three main normative concerns the teachers addressed from classrooms including getting students to participate equally, sequencing students' various solutions to review, and getting students to discourse centered on mathematical aspect were described in the paper.

INTRODUCTION

The process of creating mathematical discourse communities dealing with complex and multifaceted undertaking is a challenge for teachers (Cobb & McClain, 1999; Silver, 1996). According to the reform vision, teachers were expected to pose worthwhile mathematical tasks, help students to monitor their own understanding, and help students to question one another's ideas (MET, 2000; NCTM, 2000). Teachers are challenged by the interplay between the reform vision of instruction and their own experience with more traditional pedagogy. Research suggests that teachers need to learn mathematics in a manner is consistent with the way we expect them to teach (Cooney, 1994). Helping teachers toward an instruction rich in discourse is likely to require new experience of learning mathematics in a manner that emphasized discourse and require needed support from collaborative communities of practice (McClain & Cobb, 2001). Therefore, creating a collaborative team is considered to be the way of supporting teachers in encouraging their students to participate in discourse. The intention of the collaborative team was to provide teachers with a new experience of creating a discourse among them as learners. The paper reported here focuses on describing what norms of discourse teachers chose to address and how children evolved mathematical discourse community in classrooms.

THEORETICAL PERSPECTIVES

The theoretical perspectives for this study rooted in Jaworski's theories of teaching development include social practice theory and constructivists' perspective of learning (Jaworski, 2001). Social practice theory as described by Jaworski is concerned with the socially embedded growth of knowledge within communities of practice. Learning is seen as a process of enculturation where learners as peripheral participants in the community grow into kernel participants who represent the community of practice (Lave & Wenger, 1991). Teachers can be seen as growing into the practice of the community where their teaching is situated in classrooms and

a collaborative learning community. Constructivists' perspective of learning claims that learners construct knowledge through interactions between them and social worlds. Individual knowledge might be seen as a personal construction of the processes of teaching relative to their ongoing experiences in classrooms involving reflection and adaptation (Piaget, 1971). Alternatively, teachers' individual knowledge might be seen to derive from interaction within social settings in which teachers work (Vygotsky, 1978).

The two theoretical perspectives from development and social psychology provide a basis for helping us think about how teachers' knowledge is constructed both individually and socially. Besides, activities were structured to ensure that knowledge was actively developed by teachers, but not imposed by the researcher. The activities participants involved in the collaborative learning community included observing teaching, dialoguing as a group, and reflecting on what they had observed in classroom teaching. The normative aspects of mathematical discourse communities in each classroom was expected to be generated from teachers' negotiation and argumentation based on teaching events. Issues concerning what counts as acceptable or appropriate teaching involve a taken-as-shared sense of when it is appropriate to contribute to a discussion. The normative aspects of teaching referred to the paper are defined as teaching norms. The process of generating teaching norm is similar to the process of generating social norm or sociomathematical norm (Yackel & Cobb, 1996). The difference of teaching norm from social norm is that the teaching norm is generated from the community of teachers' professional development but the social norms or sociomathematical norms is generated from the community of classroom.

The study was designed to help teachers make sense of discourse by discussing the teaching events in which mathematical discourses should be evolved in classroom teaching and to develop teaching norms through discussing and negotiating the pedagogical meanings of teaching events.

METHOD

The study was the second year of a three-year teachers professional development program project that was designed to support teachers in implementing the recommendations of innovative curriculum into their classroom practices (MET, 2000). To achieve this goal, a collaborative team including the researcher and four second-grade teachers at a school was set up. The collaborative team was to help teachers create a community of discourse centering on mathematical ideas based on teaching events derived from their classrooms. The discourse referred to in the study includes the ways of representing, thinking, and talking, and agreeing and disagreeing that teachers and students use to engaging in those tasks (NCTM, 1991,

P. 20). The willingness of teachers to participate in the study was considered when they were recruited. They were selected from the staff of teachers who were teaching in the first grade because they were using the mandate reformed curriculum. Besides, the same mathematical topics they taught lent itself readily as a focus when they discussed in meetings after observing one another teacher's lessons.

The four female teachers were referred to as Ma, Yeh, Shia, and Su, for the sake of confidentiality. The year of teaching for Ma, Yeh, Shia, Su was 2, 2, 1, and 3 respectively. The researcher acted as a partner to the teachers in helping them put the ideas generated in discussion into practice. The researcher was expected to provide teachers with theory-oriented explanations, while they were expected to share more situated classroom experiences.

To provide the teachers with the opportunities of learning from others' concerns, group sharing was scheduled once every other week. The participants were invited to report the concerns relevant with discourse they addressed in the routine meetings after they observed a teaching. The classrooms were observed on every Friday morning and were immediately followed by a routine meeting in the afternoon. All participants observed simultaneously in the same classroom in which the instructor was one of the participants. The lessons of the four teachers were scheduled to be observed in turn. The observers were the collectors for the instructor to collect students' various solutions, because the instructor cannot stay still to collect what her students are doing and how students are thinking. Each participant was asked to choose a group to observe from the beginning to the end in a lesson in order to offer various children's thoughts to the instructor. Likewise, the teachers paid more attentions to understand how they adapted the concerns discussed in the meetings into practice. The influence of the adaptation on students' learning became as the focus of the next meeting. The teachers involved in the study conceptualizing their pedagogical knowledge through the process: formulating the problems generated from classroom events, discussing the problems and framing their pedagogical meaning in the meeting, adapting and putting their pedagogical meaning into next lesson, and reframing their pedagogy. In this generating process, the aspects of teaching norm could be formulated within this community based on the discourse of teaching events.

The routine meetings and classroom observations throughout the entire year were audio- and video- recorded. The audio- and video- tapes were transcribed. On analyzing the data by reading repeatedly the transcriptions of audio and video recordings, the statements each teacher made to the concerns discussed in the routine meeting and the way each teacher evolved discourse in classroom through the interaction among them were the major foci. An event around an issue as a unit was

coded. There were teaching norms emerged.

RESULTS

It is found that the normative aspects of teaching the teachers encountered in their mathematics classroom were centered on social aspects and then followed by sociomathematical aspects. It is not the concern in this paper. The teaching norms addressed by the teachers included: listening other students' ideas carefully, clarifying their own thinking clearly, getting students to participate equally, and sequencing students' solutions to review and report publicly, getting students to discourse centered on mathematical aspect. Limited space prevents to report each norm. Three norms related to discourse and the way the teachers evolving the norms in their classrooms are described below.

Norm 1: Getting Students to Participate Equally

At the very early of the study, a challenge the teachers faced in common was building classroom-learning communities in which students are willing to engage in investigation. Su, as an observer, described what she observed in Yeh's classroom in a routine meeting. Su stated that

...After posing the problem [*“Each carton card costs 12 dollars. John bought 2 cards and Joe bought 4 cards. How much do they cost in all?”*], Yeh asked her students to work in groups. The Group 3 I sitting next to, Jing was always authorized as an elitist student by the students in the group. Ming sitting beside Jing starts to move her chair toward Jing for discussing, while the other four students were on and off task back and forth. Ming wrote part of her solution as $12+12=()$, $10+10=20$, $20+4=24$. Immediately, her writing was erased by Jing without reason at all. Ming was upset and became silent at the moment. Jing wrote $12+12=24$, $24+48=72$ on the board with no discussion with others. She controlled this group and deprived other students' opportunity of participation (Su, Meeting, 10/05/2001).

The issue of unequal participation Sue addressed attracted immediately other teachers in the meeting. Ma shared her same unsuccessful experience that the spokesperson in a group was always the same person, even though Ma paid much attention to encourage students to review their solutions to the class. Yeh, with more research experiences in dealing with social interaction than other participants, also shared her comfortable experience. Yeh said that

...Group work became a common strategy in my instruction. Within a group, each student needed to share ideas. The spokesperson making a presentation to the class was not allowed to stand silently in the front of classroom. In case it happens, the other students' in the same group were obliged to furnish a support to the spokesperson. Reviewing the solution of each group was accomplished unsuccessfully in my classroom until I arranged each group consisting of heterogeneous students. The six students in a group consist of two from above level, two from moderate level, and two from below level. When working in-group, the high achievers have an obligation to teach the others. Conversely, the low

achievers needed to listen carefully and to learn from high achievers. The role of each student takes turns in each lesson, so that each student acted as various roles in classroom. I paid more attentions to emphasize the importance of group work than those of individual work in my teaching (Sue, Meeting, 10/05/2001).

Ma learned the way of Yeh helping students cooperate together and put this idea into her following lessons. The lesson we observed in November, she divided students into six groups. Each students of a group was assigned a job. The coordinator deals with the process of group work. The recorder records and tracks what they had discussed. The monitor takes the responsibility to check if the answer is reasonable. Spokesperson makes a presentation to the whole class. Ma tried to develop the social norm of group work and let students participate equally in discussion. The role of each student within a group takes turns by lesson.

The teaching norm of getting students to participate learning mathematics equally became the to-be-taken-and-shared issue in this community and continually evolved in the following lessons.

Norm 2: Sequencing Students' Various Solutions to Review

The teachers clearly struggled with the challenge of arranging students' various solutions to make a presentation to the class after solving a problem: in particular, for the beginning teacher, Ms. Shia. As observed, after posing the problem to students, "John brought 65 dollars to bookstore for buying 8 books. Each book costs 7 dollars. How much money did John left?" Shia posted students' group solution written on the board to review in the front of classroom. The solution from Group 5 was blank because the students in the group changed their solution and could not accomplished in time. The other solutions were exhibited in Table 1.

Table 1: Students' Various Solutions

Shia asked spokesperson of Group 2 to explain their solutions. However, the spokesperson of Group 2 merely stated the way they presented the problem rather than explained how they solved the problem. One student asked the spokesperson to explain how they got their answer. The spokesperson hesitated for a long time and finally, he said "the answer 14 was arbitrary because we run out of time".

In the meeting, Ma, one of the teachers asked Shia whether she had some criteria to arrange the order of discussing solutions generated from groups. Shia said "No! I just randomly picked up the various group solutions to discuss". As a result, the arrangement of students' group solutions to be reported became one of the foci in

the routine meeting right after Shia's lesson. The teachers agreed that the sequence of discussing students' various solutions influenced the flexibility of their instructions. The teachers arranged group solutions to report in classroom in different ways. Yeh suggested those who had higher-level thinking to report first, while Ma suggested the students who had erroneous solution to be the first. For Ma, it is impossible to report continually for other groups, as long as the high-level solution was presented. She explained that the student who reported his/her complete solution made an embarrassment to those who gave an erroneous solution.

The norm of sequencing various group solutions within the community was formulated through the teachers' discourses occurred in several teaching events. The norm was established as a good sequence of discussion affected the mathematical meanings in students' learning, so that the simple and incomplete solutions were asked to report first and then the reasonable and higher-level thinking were explained later.

Shia learned the importance of sequencing the discussion of students' various solutions and Yeh was convinced in the discussion. Yeh said:

I made the arrangement differently from the way in which I did in my previous instructions. I found my students easily understood the mathematical meanings now (Yeh, Meeting, 3/21/2002)

Norm 3: Getting Students to Discourse Centered on Mathematical Aspect

In the very middle way of the study of the first year, the participants found out that Shia's students were more talkative than the other teachers' students. From observing teachers' teaching, we found out that students conducted the discussion by themselves in Shia's classroom but the discussion of other class were conducted by teachers more often. Although Shia faced a new challenge with arranging students' solutions to make a presentation to the class, she became better to lead to students' increased comfort with presentation and public discussion. The following excerpt was an evidence for document Shia evolving a discourse in her classroom. In Shia's lesson in which enabled students to solve word problems with number sentences, she posed a problem and encouraged students to work and talk with one another in small group. The problem was that "*Ru's parents buy New Year calendar. Each calendar costs 12 dollars. Ru's father buys two and Ru's mother buys four. How much money do Ru's parents need to pay?*" After students accomplished the problem, Shia often asked the reporter of each group to report to the whole class and try not to interrupt. The following episode was the interaction of the students in reviewing Group 4's solution.

[To be continued] (S: The teacher, Shia; All: Whole class response)

S: Ok! Now, Group 4 turns. Who is going to report your way of thinking?

[Jenny was assigned to be the reporter by her group and run to the front of

classroom. She picked up a stick and pointed to her group's solution]

All: Welcome, Jenny! Speak clearly and loudly, Please! [All students say simultaneously]

Jenny: Thanks everyone! Our number sentence is $12+12+12+12+12+12=72$. [She used the stick to point the first number sentence and explained]. The first and second 12 stand for the prices of two calendars father bought and the third, fourth, fifth, and sixth 12 stand for the prices of four calendars mother bought. The answer is 72. Now! I will explain how we got this answer. First, we added $20+40=60$. 20 came from the prices of two calendars. 40 came from the prices of four calendars. Second, there are 8 dollars left from the prices of four calendars and 4 dollars left from the prices of two calendars. Therefore, we add $8+4=12$. Finally, we added 60 and 12, so $60+12=72$. We got our group's answerer was 72. Ok! Does anybody have any question?

Been: [raise his hand]

Jenny: Ok! Been

Been: I think your explaining is very clear and wonderful. Another best thing is that you always explain your number sentence based on the problem

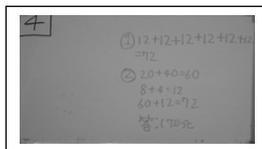
Jenny: Thanks! Any questions now?

All: No!

S: Jenny! You did a good job! Ok! Everybody gives the Group 4 an applause.

All: One, two, three, four, Group 4 wonderful! [Repeat once again]

(Shia, observation, 4/21/2002)



This episode suggests that Jenny shared her group's thinking and justified their ideas orally. The rest of the students listened carefully to her presentation. After her presentation, Jenny invited other students to ask questions in order to clarify her understanding. She offered explanation to monitor her own solution beyond procedural recitation, even though Shia had a little intervention. Been gave a good comment to Jenny to her well explanation. Shia improved the way of creating an atmosphere in which students learned to respect one another's ideas and to participate in discussions relevant with mathematical aspects.

After several discussions, the normative aspect of getting students to discourse became the one of the important concerns within this community. All members of this community agreed that the more you let students to communicate with each other, the better students know how to represent their idea clearly themselves.

CONCLUSION

The main conclusion of the study was that the teachers were supplied with the support of new experience and needed support of creating learning communities for students from the members of the collaborative learning community. They learned the roles of each member in the collaborative learning community in which the manner is similar to those of creating discourse for students in a classroom. The way of evolving teaching norms in each classroom of the community was parallel, while

the norms generated in each classroom were different.

The acceptable or appropriate teaching norms were to-be-taken-and-shared meanings within this community by investigating, discussing, and negotiating. Moreover, the normative aspects of teaching constructed in individual classroom with different or specific situated meanings were adapted from and were modified by one other classrooms of the community.

Although the teachers evolved discourse centered on mathematics ideas in their classroom, the normative aspects of discourse they encountered in classrooms could be more complex than encountered in more complex settings. The question is how to construct different levels of teaching norms to support or advance students' higher-level cognitive development needed to explore more deeply. Another question that the different levels of the normative aspects of teaching in higher grade are more complex than those of lower grade is a valuable for further investigation.

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