ON DEVELOPING TEACHERS KNOWLEDGE BY USING CASES CONSTRUCTED BY RESEARCHER AND CLASSROOM TEACHERS

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ABSTRACT
This study was designed to enhance teachers’ knowledge by constructing cases of teaching as part of a school-based professional development project. Cases were developed collaboratively by a school-based team consisting of the researcher and four classroom teachers. The participants’ conceptions of cases and their skills for cases writing were developed in the study. By constructing cases of teaching, participants increased their pedagogical content knowledge and became more reflective practitioners.

Introduction
The reform of teacher education supports a closer examination of alternative methods of instruction in teacher education programs (NCTM, 1991). The conviction has been growing that the use of cases or narratives may be more helpful for those who need to learn to think in new ways about complex problems of teaching (Carter, 1993; Harrington, 1995; Richardson, 1993). More recently, narrative case materials have become available that address dilemmas in teaching elementary mathematics (Schifter, 1996; Silver, 1999). Some research shows that even though teachers are exposed to theories of learning and teaching in some in-service teacher education programs, they do not seem able to apply this knowledge in actual classroom practice (Schifter, 1996, Richardson, 1993). The use of cases is a way to help illustrate the critical processes as teachers try to translate their theories into classroom practice (Barnett, 1991; Carter, 1993; Richardson, 1993), since learning to teach develops in part by focusing on understanding the dilemmas of teaching (Harrington, 1995).

Understanding the dilemmas of teaching is similar to overcoming the contradiction of cognition. Contradiction produces a refining of one’s cognitive structure (Perret-Clermont, 1980). Conflicts of cognition may result from two concepts that both seem plausible and yet are contradictory, or concepts that become insufficient given new evidence. In each of these cases, contradiction causes an imbalance providing the internal motivation for an accommodation. Piaget (1971) notes that the contradictions are constructed only secondarily, after learners first
search for similarities between experiences and attempt to organize each experience with their present schemes. He asserts that the way one accommodates cognitive structures which are in disequilibrium is to modify and to reorganize one’s current schemes, and thus cognitive development is achieved. With this in mind, this study was designed to create opportunities for teachers to develop specific and deeper mathematical and pedagogical content understanding through observation and discussion.

Cases as exemplars can be used not only to provide opportunities for exploring the complex problems of teaching but also for stimulating personal reflection in teaching (Merseth, 1992; 1996). The cases referred to in the study contained three elements as defined by Merseth (1996): The cases were real situation based on teaching; the cases were constructed by the study, and the cases provided statements or data for consideration and discussion by users. The use of cases includes both case discussion and case writing. Case discussion can play a critical role in expanding and deepening pedagogical content knowledge (Barnett, 1991). The case writing process itself involves an internal process, while case discussion fosters personal reflection through an external process (Shulman & Colbert, 1989). Although some research on the influences of case discussion on what and how teachers think has been carried out (Richardson, 1993; Merseth, 1996), limited research has been conducted on the development of case writing (Lin & Tsai, 1999). In Shulman’s study, case writing is developed by taking a teacher’s self-report and turning it into a teaching case (1992). There is very little research showing the effects of cases on teachers’ knowledge when cases are constructed by a collaborative team consisting of a university professor and teachers participating in a school-based teachers’ professional development project.

The professional development project upon which this research paper is based was built on the social constructivists’ view of knowledge, in which knowledge is the product of social interaction via communication and dialects in a community (Vygotsky, 1978). Therefore, activities were structured to ensure that knowledge was actively developed by teachers, not imposed by the researcher. The cases in the study were developed by focusing on the dilemmas of teaching engendered by participants’ professional dialogues and by providing them with opportunities to examine their teaching practices. Participants were frequently involved in observing teaching, dialoguing as a group, and reflecting on what they had observed.

The study reported in this paper was designed to enhance teachers’ knowledge by constructing cases of teaching as part of a school-based professional development project. There are two research questions: 1) What are teachers’ conceptions of cases? 2) How does the use of cases influence teachers’ knowledge? Teachers’ knowledge
referred to in this study included the ways of representing and formulating mathematics concepts that make them comprehensible to students. Also included in teachers’ knowledge is the understanding of how students think and what strategies students use to solve problems.

**Methodology**

It’s not possible to adequately illustrate the process of teachers’ development without dialoguing about critical pedagogical issues in which they participate (Cobb and McClain, 1999). This indicates that there is a need for what teachers are learning in their own classrooms to be communicated to their colleagues. Thus, a school-based collaborative team was set up in this study to discuss the situations which occurred in one teacher’s classrooms by comparing them to others. Classroom observation was used as a means of achieving the goal.

Ding-Pu, with about 780 students and 36 staff, is located in an urban area of Taiwan. The size of each class in the school is around 35 students. The school was selected because of teachers’ willingness to learn, principal and administrators’ support, and near to teachers college where the researcher teaches. The participants consisted of a collaborative team including the researcher and four first-grade teachers, who had taught between eight and fourteen years.

Participants with distinct experiences and beliefs were asked to share and discuss the issues of pedagogy and students’ learning in regularly weekly meetings lasting for three hours on every Monday afternoon. The researcher was expected to contribute more theory than practice, while the four teachers were expected to share more classroom experiences in regular meetings. The researcher was a partner of the teachers in helping them put the ideas generated from discussions into practice. The first-grade classrooms were the primary contexts for participants to frame problems, analyzing situations, and argue the advantage and disadvantage of various alternatives. There were two reasons for selecting teachers from the same grade to participate in this study. One reason was that the participants confronted similar pedagogical problems when they taught the same lessons. The same mathematical content easily lent itself to a focus when participants met together to address issues and solve pedagogical problems after observing others’ lessons. The second reason was that similar pedagogical issues addressed in the regular meetings drew attention and concern from each participant, and led to in-depth discussions.

Three phases of constructing cases were considered for developing teachers’ conceptions about cases and enhancing their professional knowledge and reflections on classroom practice. The first phase was to probe for teachers’ responses to cases
written by the researcher. The cases of teaching were developed from several observations by first discussing the issues addressed in participants’ lessons, and then writing them into a complete case form. The cases used in the first phase were developed from the participants’ concerns about how to present mathematical contents and about students’ learning. The second phase was to assist teachers in constructing their own teaching cases. To developing teachers’ conceptions of cases, three questions were discussed in a regular meeting: (1) What are the distinctions among the cases provided? (2) What content might be included in a case? (3) How can one construct a teaching case? The purpose of the third phase of constructing cases was to develop teachers’ ability in writing cases. The process of constructing a complete case with a narrative form involved first observing and dialoguing professionally about a lesson to initiate a case. Then accounts of teaching processes and illustration of the kinds of dilemmas which arose in instruction were discussed in regular meetings, to elicit and revise the case.

The data collected for this study included classroom observations and all discussions for constructing cases in regular meetings. In addition, each teacher was interviewed individually to collect his or her responses to the processes of conducting cases. The changes in participants’ responses over time were an indication that their pedagogical knowledge had been enhanced. The interviews and group discussions were first audio-taped and then transcribed verbatim. The transcriptions were coded and then laid out on 8k size paper, sentence by sentence, and were clustered for each participant.

Results

There were two main themes which emerged. The first theme, answering the first research question, is relevant to teachers’ conceptions of teaching cases. The second theme, answering the second research question, shows the influence of cases on teachers’ professional knowledge and teachers’ becoming more reflective practitioners.

Theme 1: Teachers’ conceptions of teaching cases: Types and contents covered in cases and ways of constructing cases

Participants distinguished between three types of teaching cases. Teacher’s analysis of children’s strategies is the first type of case. Students’ interpretations of other students’ thinking is the second type of case. The purpose of this type of case is to expand teachers’ view of students’ critical thinking ability. The third type of case shows two approaches to a specific topic, which increases teachers’ awareness of alternative approaches.
Theme 2: (1) Influences of using cases on teachers’ knowledge: Teachers increased pedagogical content knowledge

The narrative cases developed from participants’ observations helped teachers categorize the semantic structures of addition and subtraction word problems. In Sue’s lesson, the goal was to develop students’ ability to solve subtraction word problems by using chips. Three problems described below were proposed by Sue in the lesson.

Problem 1: There are 3 red and 8 green chips. How many fewer red chips are there than green chips?
Problem 2: There are 6 baseballs in the playground. Steven took 2 of them away. How many baseballs are there now?
Problem 3: There are 8 boys playing in the sand and 3 girls playing on swings. How many more boys are there than girls?

Participants were asked to distinguish between the three problems and categorize students’ strategies of solving them. Through discussing, teachers recognized the distinctions among “take away” problems, compared problems with the relational term “more than”, and compared problems with the relational term “less than”. In addition, teachers’ awareness of levels of problems was developed. They appeared to have more concerns about examining the sequence of curricular material based on students’ learning, as revealed by Yo, one of the participants, below:

“The cases we developed not only help teachers to understand the ways children think but can also help us examine whether the flow of teaching and the organization of curriculum matches with children’s cognition. (Yo, group discussion, 981204)”

At the end of the first half term of the study, each participant was to investigate the first graders’ difficulty with mathematical problems using the relational term “less than”. By observing their teaching, it was found that the pattern of erroneous mathematical expression for first-grade students was 8 – 13 = 5. We discussed the text of the case being developed, including three participants’ problems posed in their own classes and students’ various mathematical expressions for the problems. The problems described in the case included:

(1) There are 13 umbrellas and 8 students. Which number is fewer? What is the difference between the two numbers?
(2) Joe has 13 marbles. Tom has 8 marbles. How many fewer marbles does Tom have than Joe?
(3) David has 8 dollars and Kris has 13 dollars. How many fewer dollars does David have than Kris?

The participants were asked to make analyses on the higher percentage (45%) of students who used the wrong mathematical expressions $8 - 13 = 5$ for problem (3) compared to the other problems (3%, 6%). They noted that in problem (3) the smaller number (8) was presented in the text of the problem before the larger number (13). Therefore, students who were not acquainted with the meaning of the mathematical expression could not solve problem (3) using a one-to-one correspondence strategy successfully. They realized that there is one more procedure to solving problem (3) than problem (1) and (2), if first graders are to answer these problems successfully. The additional procedure required for problem (3) is to transpose the question sentence “How many fewer dollars does David have than Kris?” to “How many more dollars does Kris have than David?”. As a consequence, teachers understood that this type of problem is not appropriated for first graders who have not developed the level of reciprocal relation between subtraction and addition.

In addition, participants supported the significance and value of teaching cases for developing their deep understanding of methods to motivate students. After using cases, teachers’ concerns during classroom observations shifted from teachers’ behaviors and classroom environment to students’ learning. Cases that were developed from participants’ observations and written by the researcher helped teachers explore children’s development of mathematics ideas more in-depth. The following is an excerpt from group discussions.

“When observing a lesson, we only observed on the surface without grasping children’s thinking processes. The strategies listed in the cases make me explore deeper about children’s development of mathematics ideas. I am able to know those who understood or misunderstood and to know the ways of children’s thinking. (Huei, group discussion, 981127)”

Theme 2: (2) Influences of using cases on teachers’ knowledge: Teachers became more reflective practitioners

Having teachers respond to a case seemed to reinforce further insights into their thinking with respect to mathematical learning. Teachers became active contributors of multiple perspectives and became more reflective about their classroom practices. In addition, the third phase of constructing cases designed to develop teachers’ ability in writing cases, was likely to stimulate personal reflection. In the first meeting for conducting the case, participants’ lessons and the ensuing discussions were the particular focus or frame for problems. The discussions based on the participants’ perspectives reported in the meeting, were organized to be the content of the first version of the case.

The preparation of cases seemed to help teachers develop skill central to reflective
practice, for instance, learning to focus on alternative approaches. An example was when Ling prepared the first version of a case conducted from her teaching. The goal of Ling’s lesson was for students to learn to count by tens to 100. When first observed, Ling paid more attention to the differences of students’ performance compared to Jong’s class. Ling perceived that the differences in strategies used by students in the two classes were because of their different methods of teaching. Thus, Ling used the comparisons of two instructional approaches as the main text of the case to be built. However, Ling didn’t describe the key element in her teaching, which resulted in her students employing multiple strategies, until Jong addressed the main difference of their two approaches: Jong’s students were asked to bind ten straws into a bundle, while Ling’s students were not. Thus, the case-development process internalized Ling’s insight into how to improve her teaching students to count by tens. It is evident that writing using the context of Ling’s personal teaching enhanced her and other participants’ reflection on their teaching. Moreover, the case Ling constructed effectively included her self-reports and other multiple points of view, such as Jong’s.

Participants’ discussions transformed a teacher’s personal teaching into case writing and made participants reflect on their teaching practices in-depth. Without such re-writing activity and group member support, teacher-written cases are unlikely to achieve clarity and power. Therefore, discussing the issues of learning and teaching of mathematics with those who teach the same content is a beneficial vehicle for constructing cases of teaching.

**Conclusions**

Cases which were conducted collaboratively by a school-based team consisting of the researcher and classroom teachers brought special benefits to the participants who wrote them. Constructing cases was an effective teaching method for teacher professional development because it provided the participants’ with the opportunities to share insights and opinions in order to advance their knowledge and understanding. The case-development process prompted the participants to reflect on their practice and to become more analytical in their teaching. By constructing cases, teachers identified dilemmas of teaching and understood the purpose of the task, the presentation of the task, and the task as carried out by the students. Compared to an individual’s case writing based on personal experience, sharing multiple perspectives and comments in a school-based professional development project was more likely to enrich cases as exemplars.

Teacher development in this study included the process of writing and rewriting cases which were based on real teaching. The use of cases, including both developing participant’s conceptions about teaching cases and the processes of writing the case,
enhanced teachers’ understanding and prompted their reflection. The question of how effective the cases developed in this study may be with teachers who were not involved in the processes of constructing the cases is worth further investigation, and will be a focus in the next stage of the study.

References


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