

**Using Narrative Classroom Cases to Promote Inquiry and Reflection on Mathematics,
Teaching, and Learning
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Cases have been used in the United States for professional education in the fields of law, business, and medicine for nearly 150 years (Merseth, 1996). However, their use in the education of teachers emerged within the past few decades and gained increasing prominence since the late 1980s. Cases used in teacher education come in a variety of forms, including video and audio, CDROM, transcripts, narrative re-telling, and artifacts or records of practice. Cases may represent large or small chunks of teaching practices, they may be authored from a variety of perspectives, and they may or may not be designed to highlight specific aspects of educational practice or to be exemplars of more general ideas about teaching and learning. Cases can preserve the complexity of teaching, that is, they can illuminate an instance of authentic practice as it unfolds in a context (Henningsen, Stein, Smith, & Silver, 2000; Smith, 2001). However, cases and other records of authentic practice are not self-enacting, rather, they form the basis from which appropriate learning tasks can be designed (Ball & Cohen, 1999; Smith, 2001).

Shulman (1992) articulates several potential purposes for the use of cases in teacher education: to convey principles or concepts of a theoretical nature; to convey precedents for practice; to illuminate moral or ethical issues; to convey strategies, dispositions, and habits of mind; and to provide images or visions of the possible.

In my own work, I have used cases with a variety of audiences in both the United States and Lebanon for a variety of purposes, including to stimulate grounded discussions of pedagogy and content, simply to raise awareness of important issues for teachers and administrators, to help teachers focus more on eliciting and understanding student thinking, and to develop teachers' ability to reflect upon and analyze the teaching of others with an eye toward encouraging self-analysis and reflection. My efforts in this regard have been met almost universally with positive reactions on the part of the teacher-learners whom I have engaged in case experiences. Though many teachers and teacher educators enthusiastically agree on the usefulness of cases, there has been little systematic research examining the kinds of cases used, how they are used and what teachers learn from using them (Henningsen et al, 2000).

The present paper focuses on the use of narrative cases that have been designed specifically for use with mathematics teachers at the middle school level.¹ These narrative cases are lengthy written representations of entire middle school mathematics lessons and the context in which they took place. The cases often provide extensive information about the school context, teacher experience, broad and specific curricular and teacher goals, a full narrative summary of the lesson, and examples of student work from the lesson. At the same time, the cases are specifically designed to bring to the fore and provoke discussion about particular mathematical ideas and representations, and also to serve as exemplars of certain empirical pedagogical patterns related to how students in the case are supported to think, reason, and communicate at a high level. Two important questions to consider are (a) what, if anything do teachers learn from the case experience? and (b) how can we find evidence of their learning? Within the context of a methods course it is not easy to collect evidence of what teachers learn specifically from the cases. In this case enactment however, a deliberate attempt was made to collect evidence through teachers' work on math tasks before and after the case discussion, individual written analyses of the case, artifacts from small and whole class discussion, and individual written self-assessment of their own learning.

Exploring these Questions with Real Data

This study draws on an enactment of "Pattern Trains: The Case of Catherine Evans and David Young" with pre-service elementary teachers enrolled in elementary mathematics methods courses in university.

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The specific data discussed in this paper are drawn primarily from the work of 21 students taking the methods course as part of a “Master of Arts in Teaching” degree in the United States. The course consisted of 15 meetings of 2.5 hours each. Materials related to Catherine and David were used in Session 5 (1.5 hours on the hexagon task) and Session 12 (2 hours Case Discussion and Self Assessment) in addition to a review of the task and written homework assignment given in Session 11 in preparation for Session 12.

The Case Materials and Learning Tasks Used

The case materials used consist of two parts: (a) an activity in which learners explore a growing visual pattern like one of the patterns described in the case (the first figure in this pattern consisted of one regular hexagon and for each subsequent figure, one additional hexagon is added making a contiguous line of hexagons; first four figures were given; students asked to determine the perimeter for the tenth train without constructing it, and then write a description that could be used to compute the perimeter of any train in the pattern, using the edge length of any pattern block as the unit of measure); and (b) the narrative description of what happened in two different lessons using the same task(s). The narrative itself is divided into three main sections: (1) general background information about the school context in which the two teachers were working, (2) detailed account of a lesson taught by Catherine followed by excerpts from Catherine’s journal from different points in time following the lesson (over time she becomes less satisfied looking back on the lesson), and (3) detailed account of what happened in David’s lesson when he engaged his students in the same task as Catherine. In this case, David was more successful at engaging his students in high-level thinking, reasoning, and communication. Taken as a whole, the case illuminates ways in which a challenging task can be enacted in classrooms, affording different engagement and learning opportunities for students. The richness of this type of case supports a diverse array of interesting potential learning tasks. The 21 teachers were engaged in four main learning tasks surrounding the case materials.

Hexagon Pattern Task

The hexagon pattern task is to be completed prior to reading the case in order for the reader to experience and explore the key mathematical ideas as a learner prior to reading how the enactment of the task unfolded in a real classroom. In the present study teachers worked on the hexagon task several weeks prior to encountering the case under the auspices of learning about different strategies for promoting student-student communication in the classroom. They worked in pairs on the task for about 30 minutes followed by an hour-long whole class discussion of several solutions and their justification. Solutions were again reviewed in the week prior to when students read the case.

Read Case & Written Individual Reflection

Prior to the session in which the case was discussed, teachers were asked to read the case and take notes. They then produced individual written reflections in response to two prompts: (a) To what extent do you agree with Catherine’s own assessment of her lesson? and (b) Compare and contrast the quality of mathematical communication in the two lessons. It was intended for teachers to produce their written reflections prior to the case discussion in class; however, 8/21 actually completed their written reflections after our class discussion was completed. This serendipitous event was used in order to look for evidence of possible impact of the class discussion on reflections about the case.

Case Discussion

Teachers were first asked to discuss in small groups the similarities and differences between the two lessons in the case. In order to facilitate the discussion, groups were provided with a Venn diagram recording sheet showing two large intersecting circles, one labeled “Catherine” and one labeled “David.” They worked in their small groups for about 20 minutes and this was followed by a lengthy discussion of the similarities and differences with the professor recording student ideas on the board. To the extent possible, teacher ideas were eventually grouped into related categories in an attempt to encourage students to move from the particularities of the case to more general ideas about teaching and learning that might be embedded in the case.

Self-Assessment

Following class discussion, teachers completed a self assessment that involved two parts. In the first part, students were asked to write about what they think they learned from all the activities related to the Catherine and David case (they were asked to be as specific as possible) and what specific tasks related to

the case contributed most to their learning. The second part consisted of a growing visual pattern task in which students were asked to find and justify at least two different ways of finding a formula to describe the pattern. Students had an additional open-ended self-assessment opportunity at the end of the course in which many of them mentioned this case experience specifically.

Relating Course Goals and Case Learning Tasks

In order to begin to shed light on what teachers might have learned from the case experience, it is important to articulate how the use of the case fit into the larger course context and why the use of the case was appropriate in the first place. Figure 1 shows how each of the case learning tasks corresponded with the relevant general and specific course goals:

Relevant Overall Course Goals	Catherine and David-related tasks
To analyze and reflect on teaching	Read Case Contrast Catherine and David (written) Venn diagram activity and discussion
To understand the importance of studying patterns (algebra as a study of patterns and functions)	Read and Discuss Case Pair work on hexagon task Discussion of task solutions
To understand the value of collaboration	All of the above
Specific Goals	
To recognize problems in Catherine's teaching and appreciate her ability to reflect on them	Read case React to Catherine's reflections Contrast Catherine and David (written & discussion)
To critically analyze reform teaching	React to Catherine's reflections Contrast Catherine and David (written & discussion)
To reflect on features of real lessons involving pattern tasks	Contrast Catherine and David (written & discussion)
To further develop ability to explore, analyze, and generalize growing visual patterns and to justify formulas visually if possible	Work on hexagon task Discussion of task solutions Self-assessment pattern task

Figure 1. Case activities corresponding to general and specific course goals

Results and Discussion

The presentation and discussion of the data is organized according to the major learning tasks with which teachers were engaged with the aim of beginning to tease out what pre-service teachers might have learned from this enactment of the case. This informal analysis is intended to begin to shed light on the potential for teacher learning that case experiences may provide.

Hexagon Pattern Task and Self-Assessment Pattern Task

When students first worked on the hexagon pattern task nearly all students were able to calculate the perimeters of the given trains and the 10th train successfully. Four pairs of students (38%) were able to articulate a verbal recursive description of how the train perimeters were growing. Only one pair of students (9%) was able to build a formula to describe perimeter of any train (and they were only able to do so after the facilitator gave them a hint about relating the figure number to the perimeters), but their formula was based on numerical information and they were not able to relate it to the figures visually.

The self-assessment pattern task was given to students seven weeks later and just following the completion of all work on the Catherine and David case. In those seven weeks, the students had also spent part of another session working on a set of pattern tasks involving both repeating and growing patterns (visual and numerical). This task involved arrays of dots beginning with 2 x 3, then 3 x 4, then 4 x 5, then 5 x 6, and so on. The students were asked to write a verbal description of the 10th figure (not shown) and to find an expression or formula for the total number of dots in any figure and to show how they derived their expression. They were asked to find at least two different expressions (e.g., $(n+1)(n+2)$)

or $(n+1)^2 + (n+1)$ or $2(n+1) + n(n+1)$, and so on). All 21 students were able to write a verbal description of the 10th figure and 67% wrote a more general verbal description of how the pattern was growing. Seventy-six percent of the students were able to find at least one appropriate expression (nearly all found $[n+1][n+2]$), but only two students were able to generate more than one expression. It is clear from these data that the students learned something in the seven weeks between their first work with the hexagon pattern task and their completion of the case activities. And although it is not possible to attribute this learning directly to their work on the case activities it is likely there is a connection. As will be discussed below, many of the students self-reported that their work with the case contributed to an increased understanding of pattern tasks like the two described here.

Read Case and Written Individual Reflection

With respect to the first prompt (reflection on Catherine's assessment of her teaching), the majority of students (75%) agreed with Catherine, while the remaining students had mixed feelings about Catherine's self-assessment. In those instances, the students usually felt that Catherine was being too hard on herself. This provided the discussion facilitator with an opportunity later to push students to provide evidence to support their disagreement with Catherine, thus leading to a deeper discussion of the case. In their written reflections, students addressed a wide array of ideas related to Catherine's teaching they felt were important to discuss from their own perspective. Their written reflections provide evidence that the case experience prompted the students to think carefully about certain aspects of the case. The following ideas were addressed substantially by at least 25% of the students: Catherine was too leading/directive (81%), overly focused on correct answer /discouraged multiple solutions (67%), asking only yes/no questions (43%), overly focused on students feeling good about themselves (38%), choral responding by students can mask real understanding (38%), lack of time for exploration (29%), and self-reflection can lead to better teaching (43%). There was not much difference between the ideas addressed by students who wrote their reflections prior to the discussion and those who completed the assignment later, except that a higher proportion of students who wrote after the discussion focused on the value of teacher self-reflection and also on Catherine's excessive focus on students feeling good about themselves. These two ideas were very salient in the whole class discussion.

With respect to the second prompt (contrast communication in the two lessons), at least 25% of the students chose to contrast the two lessons according to the following ideas: student to student communication (76%), students active vs. passive (62%), exploring multiple solutions (52%), pressure for student explanation (33%), and using both right and wrong answers as learning opportunities (29%). Students who wrote after the discussion were much more likely to discuss ways in which the students were active or passive, particularly the advantages and disadvantages of choral responding. This issue occupied a large chunk of the case discussion. Also, 100% of the post-discussion writers focused on the lack of student-to-student communication in Catherine's class as compared with David's. This can be traced directly to a vivid event during the case discussion in which the facilitator challenged a student assertion by having the class act out one of the transcribed portions of the case in order to illustrate how much Catherine was dominating discussion in the lesson.

Case Discussion

The ideas generated by students during the case discussion also provide us with evidence of what they might have learned from the case experience or at least the issues about which the case prompted them to think. Preservice teachers recognized that both teachers had similar goals to engage students in high level thinking and reasoning and both teachers set up tasks for students that held potential for this to happen. They identified a variety of ways in which the enactment of the task differed in the two lessons focusing primarily on teacher-centered vs. student-centered instruction, allowing for open exploration vs. focusing on correct answers and procedures, listening to and building on student thinking, questioning, exploring multiple representations and solutions, and the role of collegial support and teacher self-reflection in improving teaching. The preservice teachers also felt it was important to point out that both teachers wanted students to feel successful and build self-esteem. However, a long discussion ensued about what it means for students to be successful in mathematics from Catherine's perspective(s), David's perspective, and the preservice teachers' own perspectives.

Self-Assessment (What they think they learned)

Although the preservice teachers addressed a variety of issues in their self-assessments, only the most commonly discussed ideas will be mentioned here. Seventy-one percent asserted that the work on the hexagon pattern task helped them see the importance of exploring multiple solutions and pathways for solving problems. A few also elaborated to say that they were learning “how to talk about mathematics a lot more” and the importance of struggling and persevering through a problem. Nearly all (95%) felt that reading the case and discussing it were the most valuable activities. About 50% specifically mentioned that the case made them think about what it means for their students to be successful in math, and that they need to rethink this issue. Sixty-seven percent talked about the relative differences in what teachers can learn about student thinking from asking more closed vs. more open questions. Finally, 43% claimed that the case discussion helped them see the importance of reflecting on their own teaching alone and with colleagues.

A few weeks after this self assessment, preservice teachers were given a more open-ended task to identify a few significant ideas about teaching and learning mathematics that they learned from the course, to present evidence of their own learning, and to talk about what course activities contributed to their learning. Nearly every person made an explicit statement that they learned how challenging teaching is and they gained a better understanding of everything a teacher has to think about when trying to help students learn mathematics. About 80% attributed most of their learning to our work with cases of real teaching. A surprising 67% referred specifically to the Case of Catherine and David (as opposed to other cases we discussed) as a major source of learning. Some notable quotations included the following: “that case helped me put all the pieces together and I tried to relate my own teaching to Catherine and David’s,” “critically reflecting on Catherine changed my approach with my students, it made me question how I can know whether my students are really understanding,” “C & D gave me an excellent contrast of good and bad questioning, like a benchmark,” “David gave me an example of what it means to be a ‘teacher as facilitator’,” “I could see how students can really learn new things by communicating with each other,” “I learned how to instigate a conversation among my students,” “I learned that students can feel successful in math without everything having to be easy,” and “the things that happened to Catherine...I’ve had them (or worse) happen to me and it helped to talk about it and see what David did and come up with ways of changing my approach.”

Conclusion

Clearly the case experience reported here was significant for the majority of teachers in the class. The evidence suggests that these teachers primarily learned from the experience how to be more successful with visual pattern tasks, strategies for promoting student communication and for eliciting student thinking, and the importance of defining what it means for students to be successful and one’s definition of success might tie in with they way one teaches. The majority of students also seemed to meet the established course goals discussed earlier. The evidence presented suggests that use of this case played an important role in their professional development as new teachers entering the field. The Case of Catherine and David may have been more salient for students than other cases (and possibly even more effective) primarily because it features two contrasting lessons that could be thought of as two cases within the larger story. This enabled the facilitator to engage students with rich analytical comparison tasks, allowing for students to possibly abstract larger ideas above and beyond the specific details of one case alone. Indeed the long-term potential power of using classroom cases resides in looking across many cases and abstracting and generalizing to larger ideas about teaching and learning than any single particular case can afford.

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