Becoming Mathematics Teachers: A Case Study of Eleven Preservice Secondary Mathematics Teachers

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Abstract

This research paper examines the complex interplay among eleven preservice secondary mathematics teachers' instructions and existing sociomathematical norms of the classrooms. The primary purpose of this research report is to provide a clearer picture of the relationships among the existing classroom's culture, the cooperating teachers' methods of instruction, and the preservice teachers' beliefs and practices. The findings of the study suggest that the existing sociomathematical norms of the classrooms have profound impact on preservice teachers' mathematics instructions and their interactions with their cooperating teachers.

Introduction

Teacher education programs cannot be conceived at the university and implemented in the schools. Rather, teacher education programs must be situated in a middle ground created by the conversations among university teachers, cooperating teachers, and student teachers. In this view we move away from hierarchical negotiation toward collaborative conversation in which each participant contributes to the telling and living out of teacher

education programs (Clandinin, et al., 1993, p.219).

Clandinin, et al. (1993) describe collaborative conversation as conversation that creates caring relationships among people. Three groups of people (university teachers, cooperating teachers, and student teachers) are all directly and/or indirectly concerned with developing preservice and in-service teachers. The authors view the preparation of classroom teachers as a collective effort of these groups and feel that each member has a story to tell that is rich in experiences. They believe in the call for fundamental changes in how students learn to teach. It would close the distance we traditionally make between the university professor and the child in the classroom.

Mahabir (1993) reflects on her early experiences of education and her present understanding of what it means to be a teacher. "I played the game. I memorized what I needed to know for tests" (p. 21). Flexibility and integration were not part of her education. Talking while working was not allowed and there were few discussions. Most of her learning was in isolation. This seemed to hold true during her university years until her student teaching experience. Her cooperating teacher, Pam, was not playing the role that Mahabir expected. The cooperating teacher's manner was relaxed and comfortable. Mahabir was allowed to make mistakes and learn from them. Her journal dialogue helped her to reflect and make new connections. She wrote:

> There were no false fronts as Pam [cooperating teacher] and I presented ourselves to the class. We shared storied experiences from our lives. I believe this makes us more real as the children connected with our stories and shared their own. We experienced a community atmosphere in which we all participated. Our shared conversations created a supportive, caring environment; a safe place for all of us to learn and to take risks (p. 26).

Reflection on teaching practices, as Mahabir was doing, is defined by Grimmett, et al. (1990) as a way of thinking about educational matters that requires introspection, open-mindedness, and willingness to accept responsibility for decisions made about teaching. Reflective practices in teaching is a means by which the teaching profession can reclaim the classroom and bring about the changes in education that have been advocated by many researchers in recent years. Educational discourse has many meanings for the word "reflection" (Munby & Russell, 1989); "there is no single appropriate definition of reflective practice and no single set of strategies that best exemplifies it" (Vaughan, 1990, ix). However, there is one common agreement among educational researchers: the purpose of any reflective approach to teaching should be the improvement of teaching and learning that goes on in the classroom at whatever level, be it elementary, secondary, or university.

Research Questions:

1. How may an existing classroom culture influence preservice teacher's mathematics instruction?
2. What role does the cooperating teacher's method of instruction play for teacher preparation?

Design of the Study

Participants

Eleven students enrolled in the Methods Course for Secondary Mathematics were the primary participants in this study. Seven were male and four were female. All the participants were Caucasian except one, an African American. All of the participants were required to take field teaching (practicum) in connection with the Methods Class. The preservice teachers' ages ranged from the mid 20's to the mid 30's.

The 11 preservice teachers did their field teaching (practicum) in different urban school settings. They taught different grade levels, from sixth to 12th grades. The preservice teachers were required to teach 36 hours within six consecutive weeks, six hours a week every Tuesday and Thursday, beginning from week four of the winter quarter.

Data Collection

The data collection process occurred in two phases. The first phase of the study began with the first week of the winter quarter 1997, and ended the fourth week of the quarter. The purpose of this phase of the study was to gather background data and included (1) group discussion and negotiation of the course procedures with the participants, and (2) discussion of required texts (see bibliography).

The second phase of the study started the fourth week of the winter quarter, 1997, and ended the tenth week of the winter quarter, 1997. The data sources included: (1) two observations by the researchers of the preservice teachers' classrooms during mathematics instruction, once at the beginning of the field teaching and the second at the middle of the field teaching; (2) informal one-on-one conversations with the cooperating teachers; (3) classroom dialogue every week for three hours to discuss teachers' reflections of their classroom activities and on their observation of videotapes, and (4) the researchers' field notes.

The second observation by the researchers of all participating preservice teachers was videotaped. All participants were provided copies of their

tapes for self-reflection and self-evaluation immediately after the observations. They were required to share 20 minutes of their teaching with peers in the Methods Class for classroom dialogue. All the dialogue in the Methods Class was audiotaped and partially transcribed. In addition, as part of the course requirement, the participating teachers were asked to keep systematic entries of their teaching reflection and to keep a portfolio for final analysis.

Analysis

Data from the preservice teachers' systematic written reflection on the teaching and classroom interactions, their portfolios, partial transcripts of audiotapes of mathematics dialogue meetings, partial transcripts of videotapes gathered from preservice teacher's classroom teaching, informal conversations and discussions with the cooperating teachers, and the researchers field notes were analyzed using a constant comparative method (Lincoln & Guba, 1985). The emerging categories from the multiple data sources were examined using a matrix of categories to find possible explanations for the research questions.

Results

The constructivist teacher and/or the constructivist classroom vs. the traditional teacher and/or the traditional classroom are frequently referred to in this paper. The environment of the constructivist classroom encourages mathematical reasoning, problem solving, conjecturing, and inventing. In such an environment the students are regarded as a community of learners and not just a room full of individuals. The constructivist classroom treats mathematics as a study of patterns and relationships. By contrast, the traditional classroom treats mathematics as a body of isolated facts. The emphasis in the traditional mathematics classroom is mainly on getting one right answer with the teacher as the sole authority for answers (NCTM, 1989).

A constructivist teacher is defined as one who values classroom communication through classroom interactions pertaining to what constitutes an appropriate answer. For example, when students are engaged in meaningful mathematical activities, they are provided the opportunity to explain and justify their solutions within their small cooperative groups as well as in whole class discussions, thus engaging the students to establish the norms (Cobb & Yackel, 1996; Wood, et al., 1993; Yackel & Cobb, 1995). The opposite of the above examples can be referred to as traditional when the teacher's emphasis on mathematics instruction focuses on quick numeric answers to teacher's questions, students' responses, and teacher's evaluation.

In general, the eleven beginning teachers' beliefs and classroom practices can be grouped into four categories according to teaching orientation and

existing classroom norms.

The First Category: Constructivist in Traditional Territory

The first category relates to those teachers who were placed in classrooms with cooperating teachers whose mathematics instruction and classroom norms were traditional. The preservice teachers, however, who were placed in those classrooms expressed beliefs and attitudes towards teaching and learning mathematics consistent with a constructivist philosophy. Within the dialogic community of preservice teachers in the methods class, Bob and Stan were critically and openly engaged in their small group interactions as well as in whole class discussion regarding their beliefs toward teaching and learning mathematics consistent with constructivism. For example, in one of our classroom dialogues, Bob expressed his beliefs this way, "Throughout my education, I have found that the best way to increase one's understanding of a topic is to be willing to allocate the time needed to understand it" (Bob's classroom dialogue). Similarly, Stan reflected in one of his writing assignments, "I understand Galileo to be a thorough-going constructivist. Instead of focusing on explaining concepts, I see the value of guiding students through the zone of proximal development" (Stan's written reflection).

Bob and Stan were placed in a traditional classroom setting. Even though the existing established norms of the classrooms in these two cases did not encourage students' problem solving, reasoning, communication and mathematical connections (NCTM, 1989), Bob and Stan challenged the existing norms and integrated various approaches to small group cooperative learning. They focused on mathematical modeling and encouraged their students to become independent learners. Their instructional approaches were directly in contrast to that of their cooperating teachers' mathematical instruction. For example, in one of Bob's classroom teaching episodes, Bob and his peers in the methods class watched 20 minutes of his classroom teaching and discussed about his teaching method.

Stan: You [Bob] engaged the students. It was a very good idea to ask them to come in front of the class and demonstrate.

Bob: When I realized that many of the teaching techniques I seek to improve are the same techniques that other student teachers are also hoping to improve, then I feel encouraged that my failure to achieve perfection is not completely due to inadequacies on my part, but to some degree is a reflection of just how hard it is to be an excellent teacher. I think it is helpful for the students to see that teachers do not always have the answers at their fingertips. (Methods classroom dialogue.)

Stan started his field teaching in a classroom where the students were expected to do mathematics individually and turn their work in to the teacher for evaluation. This routine was followed every day in a similar manner. While the cooperating teacher heavily focused on direct instruction, Stan encouraged the students to come up with a "rule" and asked them to write down their definitions.

> I feel I achieved a greater quantity and quality of participation out of the class than the cooperating teacher usually does. I took advantage of the opportunity to discuss multiple approaches to the problem rather than simply to solicit an answer and work the problem on the board for them (Stan's teaching reflection).

When the cooperating teacher was absent, Stan's students thanked him for his way of teaching. "I think it is because the class centered around the students and that I cast myself in the role of an educational assistant who tries to find ways to help them understand" (Stan's teaching reflection). Bob and Stan not only questioned the problematic nature of their cooperating teachers' instructional approaches but also took risks and tried to develop their own teaching methods consistent with constructivism.

The Second Category: Adopting Local Customs and Traditions

The second category belongs to the preservice teachers who were not traditional in their beliefs but, when they were placed in traditional classrooms with traditional teachers, they followed the similar instructional approaches as their cooperating teachers. Ted and Joan belong to this category.

> I taught the traditional way of lecturing and doing problems on the board. My cooperating teacher told me what he wanted me to teach. He felt the students would feel more comfortable with this style since it is the way he teaches. (Joan's teaching reflection)

Even though these preservice teachers questioned the limitations of their cooperating teachers' methods of instruction, they had not reached the level of challenging the existing classroom mathematical climate. They mainly followed direct instruction suggested by their cooperating teachers. During the classroom dialogue and their systematic reflecting they mentioned that they valued a "student-centered" classroom. They were aware of the importance of student/student and teacher/student interactions, but in practice they had not figured out what the role of the mathematics teacher was and

how students learn mathematics. For example, Ted compared teaching with coaching. "Some people do not view coaching as teaching, but I would argue with that opinion. So I have always viewed myself as a teacher and a coach" (Ted's teaching reflection). With that belief, Ted showed in practice that mathematics teaching involves the teacher standing up in front of the room and demonstrating the lessons clearly and carefully for the students in order to help them understand the concept. He talked about students' involvement in problem solving but in practice he would "show" how to solve problems. The students were passive receivers of the information given by the teachers.

As the quarter progressed, Ted became very critical of his cooperating teacher's methods of instruction and the classroom environment. "I hope that I would have the decency to get out of the profession for the benefit of the students" (Ted's teaching reflection). Although Ted criticized his cooperating teacher's method of instruction as being "too dry and boring," he had not yet figured out what mathematics teaching ought to be. On the one hand, he believed he needed to bring more meaning into the mathematics classroom. On the other hand, his actions and practice revealed his perception that mathematics learning occurs from the teacher's head to the student's head if only he instructs the lesson clearly and carefully. As an aspiring teacher, Ted was willing to take risks and invest the time and effort to enhance his teaching. "I would like to get to a point where I do not have to do all the lecturing, a point where all I need to do is ask the proper inquiring question" (Ted's teaching reflection). As we were getting closer to the end of our quarter, Ted became more and more critical of his direct instruction. He became aware of the problematic nature of his "lecturing." Through observing others' videotapes, dialogue with his peers, and his written reflection, he realized the value of students' active engagement in mathematical problem solving. Ted was searching to find a better method to enhance his students' learning.

Joan followed a similar approach. The only difference between Ted and Joan's teaching methods was that Ted used mathematical modeling such as using transparencies for fraction bars and different slices of pizza to teach fractions. Joan mainly used the "chalk and talk" approach similar to the cooperating teacher's mathematics instruction. "When I have my own classroom I would like to incorporate some group activities and keeping a journal in which the students explain what they learned" (Joan's teaching reflection). Even though there was no change in Joan's classroom practices, the influence of the dialogic community on her beliefs was clear. Participating in small group discussions with her peers provided her opportunities to question some of her fundamental beliefs about teaching and learning mathematics. "I really believe that you learn a lot from others who have tried different approaches to teaching mathematics" (Joan's portfolio).

The Third Category: Visitors to Familiar Lands

The third category includes the preservice teachers (Matt and Debby) who were traditional and were placed in traditional classrooms with traditional cooperative teachers. The difference between these preservice teachers and the preservice teachers in the second category is that these teachers not only accepted the traditional methods of direct instruction but also, particularly in Matt case, he strongly supported the cooperating teacher's method of instruction. For example, Matt several times in our dialogue meetings as well as in his written reflection admitted that direct lecturing best satisfied him.

> We are told that lecturing is not the best form of teaching, but that is all I ever see as a student. Personally I like the lecture method and do not see myself using cooperative learning. I feel in mathematics that lecture is the most effective way to present the material to the class. That is how I feel right now (Matt's portfolio).

Matt and Debby both were consistent in their beliefs and their classroom practices. They believed that the students learn mathematics best when the teacher instructs them. The teacher's role, according to Matt and Debby, was to clearly lecture mathematical ideas and direct the students throughout the steps. "In all of my college classes lecturing was the main form of teaching the class. So, I guess I am just used to this form of teaching" (Debby's portfolio). Although, Debby followed her cooperating teacher's method of instruction, there was one significant difference between them regarding their attitudes toward students' learning. The cooperating teacher had a very passive and negative attitude toward the students' potential for learning. Debby, on the other hand, believed that a teacher can and will make a difference regarding the students' learning. "I did not learn much from him during my field experiences" (Debby's teaching reflection). The Methods Class discussion and dialogue did not have any significant impact on Debby's and Matt's beliefs and classroom practices. Their self-reflections and interactions with their peers did not move beyond information sharing and their descriptions of their teaching. They showed little interest in self-critique. "I was taught this way. I learned this way. And I will teach this way. Lecture format works for me" (Methods classroom dialogue).

The Fourth Category: Explorers in an Exotic Country

The fourth category belongs to the beginning teachers who, in theory, believed in constructivism and were placed with cooperating teachers whose teaching methods were consistent with constructivism. Patty, Jim, Joey,

Jane, and Eddy are in this category. Based on the relationships between the cooperating teachers and these five preservice teachers, three sub-categories emerged within the fourth category. The first sub-category consists of Patty and Jim. Their relationships with their cooperating teachers were like mentee and mentor. They observed their cooperating teachers for the first week and received guidance about what and how to teach and they followed that model consistently. Both Patty and Jim had full support of their cooperating teachers. They expressed their feelings towards their cooperating teachers during their teaching reflections this way:

Patty: I was happy to find that my cooperating teacher was not a traditional math teacher who stood in front of the room and lectured. I was happy to find that he felt that the students should work together in groups (Patty's teaching reflection).

Jim: I basically tried to stay within the framework that my cooperating teacher developed in her classroom (Jim's teaching reflection).

The second sub-category consists of Joey and Jane. Their cooperating teachers' instructional methods were consistent with constructivist teaching as it was for Patty and Jim. The only difference between the first and second sub-categories was the level of professionalism and the relationships between cooperating teachers and preservice teachers. While Patty and Jim experienced a mentoring relationship with their cooperating teachers, the connection between Joey and Jane with their cooperating teachers was based on collegiality. They respected each other as colleagues. No one was the expert and no one was the novice. The cooperating teachers provided the preservice teachers freedom to design and develop their teaching methods. The exchange of ideas and information and the learning process were reflexive. They critiqued each other openly and knew that they would not lose respect as a result of that. For example, both Joey and Jane constructively critiqued their cooperating teacher's lack of encouraging students to work in their small cooperative learning groups and, furthermore, Joey communicated with his cooperating teacher about the importance of students' writing mathematics.

Jane: I felt much freer to do my things. I felt that I didn't have to follow her lead. I could choose my own path (Jane's teaching reflection).

Joey: In my own class I will try to incorporate more cooperative learning and group investigations. Some of the students seem to be stuck on a set of problem solving techniques which are sometimes inappropriate. I will try to encourage more creation of one's own meaning on a particular problem. I will probably try to bring more writing into the classroom with students explaining their answers on papers (Joey's teaching reflection).

The last sub-category within the fourth category was Eddy's relationship with his cooperating teacher. Due to his late placement, Eddy had no opportunity to observe his cooperating teacher's mathematics instruction. However, through our informal conversations and observations of the classroom environment we found that Eddy's cooperating teacher was aware of current research on mathematics teaching and learning. He encouraged Eddy to get involved in professional organizations such as NCTM. He recommended resource materials for Eddy to read such as *Curriculum and Evaluation Standards* (1989). Eddy had the full support of the cooperating teacher to design his lesson plan autonomously. The classroom atmosphere was non-threatening and open. The students were free to move around and work cooperatively. "I began to study the textbook, not only to refresh my memory, but also to see what approach the book would take" (Eddy's teaching reflection).

Although Eddy started his teaching by focusing on a textbook and direct instruction, his beliefs had come a long way from the traditional ways of looking at teaching and learning to an approach that was consistent with constructivism. "The seed of change" in Eddy's beliefs actually started before the quarter of the study when he began to ask questions about the limitations of direct instruction. However, starting the quarter of the study, Eddy was still using direct instruction. He became critical of his "traditional method" and began searching for some possible alternatives. "I felt, in retrospect, as though I just handed them a collection of facts and a couple of skills (conversion factors) and expected them to be excited about it" (Eddy's teaching reflection). Although Eddy struggled to make his mathematics instruction more consistent with his beliefs, he continued to bounce back and forth between dispenser of knowledge and facilitator of mathematical meaning. This was due to lack of experience and also due to the complexity of the mathematics content that he was teaching (11th and 12th grade, Advanced Algebra). Eddy became strongly convinced that he could not move backwards.

> I have always assumed that I would use traditional methods as an instructor. They worked on me so they must be okay. But, beginning this quarter I began to see that regardless of why these methods are no longer working (if they ever were that successful), something must change, and I have no control over anything other than what I do. That was the beginning of my seed of change. The old linear methods of drill and practice and dry lecture will have to make way for whatever I can find that will work with today's students, and this will probably differ from class to class. This quarter I realized that I am narrow-mindedly focused on the material to be taught...I hope to be able to step away from the old methods I grew up

with and try more student-centered involving cooperation, discovery, and inquiry. (Eddy's teaching reflection)

Discussion

For these eleven preservice teachers, the degree of reflectivity and self-critique about their beliefs and practices did not follow in a similar pattern for all the participants. The effect that took place within each individual's beliefs and practices was closely related to their personal experiences, environmental (local) situations, and cultural background (Hatch & Gardner, 1993). For example, Matt's and Debby's level of reflectivity had not moved beyond information sharing and classroom description. They clearly indicated that, based on their own learning experiences, they always had believed and still believe that mathematics should be taught and learned by "lecture format". Even though they questioned some of their teaching practices such as, "Is this lesson I am teaching teacher-centered or student-centered?" (Matt's words), their level of reflectivity had not reached to self-critique and the reconstruction of their beliefs and classroom practices (Smyth, 1989). On the other hand, Ted and Joan come to realize the problematic nature of their classroom practices. Due to the existing classroom environment and lack of prior experience regarding constructivist teaching, they had not stepped out of their direct instruction. However, their level of self-critique increased as the study evolved. "Reflecting and critiquing myself will only make me a better teacher" (Ted's words). The rest of the participants, to certain degrees, reconstructed their beliefs and classroom practices. They had strong support of their cooperating teachers (except Bob and Stan). "We were much more effective as a team" (Jane's words). They had open and genuine dialogue with their cooperating teachers. They experienced the value of risk-taking. They became relatively comfortable with uncertainty and the complexity of classroom situations.

The benefit of being in a dialogic community came through the support and reinforcement of educational concepts through the observation of others' teaching and the commentary and dialogue that followed each observation. Participation in the dialogic community and the influence of the dialogue on the participating teachers' self-confidence had some impact on their relationships with their students. By experiencing and valuing a free and open discussion among themselves, they created a less threatening environment for their students' interactions. This, in turn, allowed for a more egalitarian atmosphere in their classroom settings (Pourdavood & Fleener 1997). "Such an open environment encourages free expression which allows us to evaluate our students' comprehension and then adjust our teaching pace or style accordingly" (Stan's teaching reflection).

An interesting dimension of these findings is the impact that existing classroom norms and the cooperating teacher's method of instruction had on preservice teacher's beliefs and practices. As stated earlier, the effect that takes place on each individual preservice teacher's beliefs and practices is closely related to personal experiences, environmental situation and cultural background.

In Joan's case, the cooperating teacher used the same teaching techniques (direct instruction) that Joan was familiar with from her own background. The cooperating teacher passed out homework and the students worked individually.

> When I did field teaching I taught the traditional way of lecturing and doing problems on the board. My cooperating teacher told me what he wanted me to teach and he felt the students would feel more comfortable with this style since it is the way he teaches. (Joan's Teaching Reflection)

Joan accepted and followed this type of instruction throughout the six week period of teaching.

Joey's cooperating teacher provided him complete freedom to develop his own teaching methods. The existing classroom climate, the freedom and support from the cooperating teacher and Joey's prior beliefs and attitude toward constructivism set his field teaching off to a good start.

On Jim's first day of field teaching, he took some time at the beginning of class to tell his students about himself. Jim's talent at building a caring community was closely related to his background experience working with children in his town's summer recreation program. Jim followed the similar approach of his cooperating teacher. The classroom was mainly student-centered.

Debby's cooperating teacher's attitude towards his students reminded Debby about her past unhappy experience when she was a junior in high school. She had high hopes of having the type of cooperating teacher that she was aspiring to become, but she was disappointed. "As a result, I did not learn much from my field experience" (Debby's teaching reflection).

Patty's cooperating teacher, as he observed Patty's teaching, recognized the value of creating time and space for the students to express their thoughts and to construct their own meanings. "A few of these students I thought would never volunteer, but when I saw them volunteer I was thrilled" (One-on-one conversation with Patty's cooperating teacher).

Significance

Although maintaining equal professional relationships among the participants as they established a learning community significantly influenced the synergy and effectiveness of the community, the power and impact of a dialogic community on the cooperating teachers has not been tapped. The egalitarian relationships of the eleven preservice teachers empowered them to take risks and self-critique in a non-threatening climate. If in-service teachers are willing to become a part of such a community, then their energy, enthusiasm, and years of teaching experience could not only influence and shape the learning community but could be influenced by the complex interactions within the community. Ultimately, empowering early career as well as established teachers is critical for nurturing learning communities which are adaptive and creative.

Current restructuring of schooling at all levels will facilitate the creation of an atmosphere of collaboration among universities and Public schools. The changing nature of university/school partnerships with respect to teacher professional development needs further study. Specifically, rather than the university personnel assuming a leadership and solution-giver role, the continued support for collaborative efforts allowing teachers to form dialogic communities and direct their own areas of change needs to be further developed and understood. Further research on professional development opportunities where teachers act autonomously and direct their own change is needed. This research could lead to models of professional development that are more authentic and meaningful for teachers and their school communities.

Current restructuring efforts include early career and/or preservice teachers working with experienced teachers and school personnel. Further efforts to provide a climate for all teachers to critically examine teaching practices must include school restructuring so dialogic communities can be formed.

An axiom that all of us who are dedicated to improving teacher professional development might do well to remember is found in Eddy's words:

I have no control over anything other than what I do. Old methods will have to make way for whatever I can find that will work with today's students and this will probably differ from class to class. (Eddy's teaching reflection)

References

Clandinin, D. J., Davies, A., Hogan, P. & Dennard, B. (1993). *Learning to teach teaching to learn* (pp. 218-222). New York, NY: Teacher College Press.

Cobb, P. & Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. *Educational Psychologist 31* (¾) 175-190.

Grimmett, P. P., Mackinnon, A. M., Erickson, G. L. & Riecken, T. J. (1990). Reflective practice in teacher education. In R. T. Clift, W. R. Houston, & M. C. Pugach (Eds.), *Encouraging reflective practices in education: An analysis of issues and programs* (pp. 20-38). New York, NY: Teachers College Press.

Hatch, T. & Gardner, H. (1993). Finding cognition in the classroom: An expanded view of human intelligence. In G. Saloman (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 164-187). Cambridge University Press.

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage Publications.

Mahabir, H. (1993). Autobiography as a way of knowing. In D. J. Clandinin, A. Davies, P. Hogan, B. Kennard (Eds.), *Learning to teach teaching to learn* (pp. 19-27). New York, NY: Teacher College Press.

Munby, H. & Russell, T. (1989). Educating the reflective teacher: An essay review of two books by Donald Schon. *Journal of Curriculum Studies* 21, 71-80.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics K-12*. Reston, VA: NCTM, Inc.

_____. (1991a). *Connecting mathematics 9-12*. Reston, VA: NCTM, Inc.

_____. (1991b). *Developing number sense in the middle grades 5-8*. Reston, VA: NCTM, Inc.

Pourdavood R. G. & Fleener M. J. (1997, Oct.). Impact of a dialogic community on the development of classroom sociocultural norms. *Journal for a Just and Caring Education 3*, 399-417.

Smyth, J. (1989). Developing and sustaining critical reflection in teacher education. *Journal of Teacher Education 40*, 2-9.

Tsuruda, G. (1994). *Putting it together: Middle school mathematics in transition*. Portsmouth, NH: Heinemann Press.

Vaughn J. C. (1990). Foreword. In R. T. Clift, W. R. Houston & M. C. Pugach (Eds.), *Encouraging reflective practice in education: An analysis of issues and programs* (pp. vii-xi). New York, NY: Teacher College Press.

Wood, T., Cobb, P., Yackel, E. & Dillon, D. (Eds.). (1993). Rethinking elementary school mathematics: Insights and issues. *Journal for Research in Mathematics Education*. Reston VA: NCTM, Inc.

Yackel, E. & Cobb, P. (1995). *Classroom sociomathematical norms and intellectual autonomy*. Proceedings of the 19th Conference of the International Society of the Psychology of Mathematics Education, Recife, Brazil.

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