

CHANGES IN MATHEMATICS TEACHING:
LEARNING WITH AN EXPERIENCED ELEMENTARY TEACHER

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Despite a history of teachers' resistance to change, researchers in mathematics education have learned that mathematics teachers can change. The process of change, however, is usually long-term and difficult. This paper discusses the issue of change from the teachers' perspective. How do teachers' perceive their own, professional changes? What are factors that teachers consider as catalysts for their processes of change? Through the stories of a very experienced elementary school teacher, one learns that teaching is a dynamic job, impregnated with short and long-term changes. Contradicting the image of teaching as repetitious, this teacher sees the development of her mathematics teaching as a continuous learning process that has gone through many phases and incorporated many changes.

If a group of elementary teachers from the early 20th century could travel in time and visit a 21st century classroom, there would be few elements they would not recognize. For the most part, however, these educators from the last century would be able to understand what the classroom teacher was trying to do and could take over the lesson. This parable, used by Papert (1993) to claim that education has not changed as much as it should over the past century, brings to mind an image of teaching as a repetitive, monotonous job in which changes seldom occur.

Although in his book Papert presents innovative teachers and separates issues about teachers as individuals from those about schools as institutions, images of teaching as a static job and of teachers as professionals who perpetuate certain practices are pervasive in the educational literature. Teachers, it appears, do the same things one day after the other, one year after the other. Teachers also do the same things generation after generation. After all, teachers tend to teach in the way they were taught (Ball, 1988).

In recent change- and reform-related studies in mathematics education, we have learned that despite a history of resistance to change (Cuban, 1993) teachers can successfully implement modifications in their practices (e.g., Fennema & Nelson, 1997; Ferrini-Mundy & Schram, 1997; Schifter & Fosnot, 1993; Webb & Romberger, 1994; Wood, Cobb, & Yackel, 1991). Changes in mathematics teaching, however, are usually the result of sustained partnership and leadership, on-going collaboration, and long-term support for teachers to embrace new recommendations for school mathematics. Thus, although researchers in

mathematics education have come to accept that mathematics teachers can change, the process of change is perceived as a long-term, difficult, and slow effort.

This paper discusses the issue of change from the teachers' perspective. How do teachers' perceive their own, professional changes? Do teachers believe they modify their teaching practices over the paths of their careers? If so, what are factors that teachers consider as catalysts for their processes of change? These are questions addressed in this report.

Analyzing data from Helen¹—an elementary school teacher with 31 years of teaching experience—one learns that teaching is a dynamic job, impregnated with short and long-term changes. Contradicting the image of teaching as repetitious and static, Helen sees the development of her mathematics teaching as a continuous search process that has gone through many phases and incorporated many changes.

The Research Project

My research aims at better understanding elementary school mathematics teaching. Toward such a broad goal, it is necessary to identify the knowledge elementary teachers construct, and understand how such knowledge changes throughout the teachers' careers. It is also important to relate changes in practices to changes in knowledge, connecting specific practices to knowledge that supports it. One of the specific objectives of this study was to trace the history of teachers' personal knowledge and teaching practices, identifying turning points and factors that, from the teachers' perspective served as catalyst for change. This report focuses on the teachers' perceptions about changes in practices.

During the past decades, researchers' understanding of teachers has greatly expanded. Beginning in the 80s, there has been an ongoing movement to strengthen teaching as a profession (Carnegie Forum, 1986; Holmes Group, 1986), and the development of teachers' knowledge-base for teaching has become of utmost relevance. Various theoretical positions have led to different typologies that categorize teachers' knowledge and its sources, as well as research programs that target the topic (Fenstermacher, 1994; Gauthier, 1998; Schulman, 1986, 1987; Tardif, Lessard, & Lahaye, 1991). Despite differences, it is accepted that teachers construct professional knowledge through their teaching practice.

To understand teachers and their knowledge, an "epistemology of professional practice" is needed. Tardif (2000, p.13) defines this epistemology as the study of the set of knowledge used by professionals in their everyday working space to accomplish all their tasks. From this perspective, teachers' knowledge is personal and time dependent. It depends on teachers' life histories and develops throughout their careers. Tardif and Raymond (2000) propose that to learn about a teacher's

¹ Names are pseudonyms.

knowledge one should ask her/him the history of her/his personal knowledge-base for teaching. Connected to such history is the history of the teacher's mathematics teaching practices.

This report is part of a larger project in which I worked with 5 elementary school teachers, exploring their stories about mathematics teaching. All teachers have over 20 years of teaching experience, and they have been teaching at the same school for the past 10 years. I identified factors that, from the teachers' point of view, were important in the establishment of their ways of teaching mathematics to young children, and factors that served as catalysts for change their mathematics instruction.

To discuss her career and consider factors that were relevant in the establishment of her mathematics teaching, I interviewed each teacher three times. The instruments used in these interviews were a timeline based on the teachers' responses to an inventory of their teaching experiences, a logic-spider with knowledge for teaching mathematics as the central theme, and a life-line (Connelly & Clandinin, 1994). The goal of these instruments was to offer teachers different approaches and opportunities to recall their experiences in different schools and classrooms. The research instruments also helped teachers organize their accounts, looking for continuity and change. In a final group interview, teachers discussed issues that were repeatedly mentioned in individual interviews.

All interviews were audiotaped and transcribed. Teachers received copies of the transcriptions. Data was analyzed through constant comparison method using initial descriptive categories such as knowledge, early teaching, later years, types of change, catalysts for change, and developing own teaching. Although the stories of all 5 teachers were interesting and had many similarities, the case of Helen was selected for presentation in this paper because she is the participant with the most teaching experience. Many ideas presented by Helen, however, were true for other teachers as well. In particular, the notion that becoming a teacher is an on-going change process was addressed by these experienced teachers.

Helen, Mathematics Teaching, and Perceptions on Change

Helen earned a B. S. in Elementary Education in 1969 and a master's degree in Elementary Education in 1970. She began teaching 3rd grade in 1970. After that, she taught 2nd grade, 5th grade, and remedial middle school mathematics. Since 1984 she has been teaching 1st grade, and in 1990 she began teaching at the school where she is now. During her many years of teaching, Helen has completed graduate level courses in education and has attended staff development courses in mathematics education.

Helen thinks her mathematics teaching has greatly improved during her career, particularly during the past decade. She considers herself a good teacher, especially because she thinks her students are excited about mathematics; they

enjoy studying it, they think it is fun, and they appreciate when Helen tells them "it's math time."

I think I am a good teacher. I have taught a long time and I have changed some things, some things that didn't work. You know, you have to change. ... I would say the last third of my teaching career has been my best years of teaching math, because of the changes that I have made in the way that I have taught math. ... I am more satisfied with what I have done. Because I can feel a sense of pride whereas before, you know, there was not that much. ... I think that my teaching style developed, it sure matured. Then you become so much better at it. And I think any time you have children involved in what they are doing and have a say in it, then it is better teaching.

For Helen, teaching mathematics is an ongoing learning and change process. In her path to becoming a better mathematics teacher, Helen believes she formed her own way of teaching mathematics. She feels great ownership of her current mathematics teaching, which she calls eclectic. Her teaching approach represents a mixture of teaching resources she acquired throughout her career. Helen claims teachers need to try a variety of ideas in their classrooms and keep the ones that work, that is, that help students learn. In this way, after many years of teaching experience, teachers build a rich web of ideas for the classroom.

You can't just say, okay, open up your math book and do page so and so. You can't do that. I mean, that is not teaching. So I think that you have to just pull from every source, and do everything that you can, and try new things. And then, if they don't work, then okay, I have tried it, it didn't work, so I will move on to something else that will work. ... There is a time when you have to do some paper and pencil things. I mean, there are times when you have to do that. But then there are some times when you can teach it another way that is not paper and pencil, there are some manipulatives that you can use and games that you can use. ... [Because] there is no one best teaching method. You know, you have to pull from everything. You just can't do it one way. ... If you use a variety of teaching methods you will have better math students.

Developing this eclectic approach, that combines different resources, ideas and teaching methods, symbolizes for Helen her growth in mathematics teaching. This development is a learning experience that occurred over time and required many changes from Helen. Her current teaching was constructed and no one could have given it to the teacher. Helen's eclectic combination of ideas is the result of her many experiences in mathematics and the different trends she faced in the teaching of mathematics. It was built through many trials, revisions, reflection, and changes.

[In my personal life] I don't like change very much. I mean, I stress over it. Whereas in teaching, you have to change because there are so many things going on, you know, so many cycles that you are going through. ... I think I was taught in college right out of the book. And so when I started my teaching that was what I did. It was right out of the book, there was no hands-on.... I put a lot of board work up, you know, lots of problems on the board and all. And for a long time, that was the way we did it. ... And then I found out, you know, that really isn't the way to teach math. And probably some of the greatest experiences would have been with, when I came here and they were doing Math Their Way which I was not familiar with. And it was so hands-on. It was just such a different type of math that, really, you could understand the why of math.

Helen attributes the changes she has made in her mathematics teaching style to a few different factors—for example, the courses she took on Math Their Way, a late 1970s activity-centered mathematics program for early childhood education. Among the factors that mostly influenced her changes, Helen mentions moving to a different school, sharing teaching ideas with colleagues, and attending workshops.

I think probably one of the things that have had a great impact was the change in schools and the different colleagues. I think that probably has had one of the greatest impacts on my teaching of mathematics. ... There have been a lot of opportunities here [at this school] where you can grow and do a lot of things, and then the teachers in my hall worked so well together, so if somebody is doing something that you like, you know, you can say, hey, you know, let me do that. ... [In other schools] there was no sharing. ... I think probably some of the influence of the Math Their Way when I came here which I had not had in other systems. And when I saw how it was being taught and that whole philosophy, how to teach math was so different from these other things. And using so many different ways to teach one concept. That had a big impact on me. ... And then going on to math workshops and finding out what is going on.

Schools, colleagues, and participation in workshops are factors one can consider as directly related to Helen's own career and personal choices. Helen also attributes some of her changes to another set of factors more related to changes in education in general, and mathematics education in particular. Over her many years of teaching experience, Helen has lived various recommendations for school mathematics. She has experienced different trends and the availability of different resources for mathematics teachers.

And then also, the new ideas that came from, that came into being. Like when I was telling you earlier. When I first, those first years when I went

into teaching, individualized structure, now, that was the catch phrase. And then after that it was open classrooms, where we had centers. Well, then that was kind of passé and they went into using a lot of manipulatives and that kind of thing. And then we came into Math Their Way. So, I mean, it is just the different, all of these different things have been floating around ... A lot of times we do have a math book, then all of the things that are taught in there are taught according to whatever is the "hot" way to do it at the time. So, that influences, too. And also, then all of the monies that are available in the school. And they will say, "You can spend the money on something, what do you want to buy?" Well, then we are looking through [lists of resources] and seeing all of the things that seem to be working in classrooms ... [You are also] influenced by the materials that are bought.

Discussion

It is interesting to observe that, in Helen's stories, recommendations for change in mathematics teaching that are "floating around" make their way in to the classroom. These recommendations are mediated by school administrators, mathematics consultants for school districts, books and other resources available for teachers. As education goes on different pendulums, so do teachers. And as teachers swing, they learn new ideas, incorporate new suggestions, and develop their eclectic teaching. Teachers learn from different sources. They use all they can to do what they believe is best for their students. Thus, as new educational ideas come around, teachers change; as new recommendations for mathematics teaching are proposed and shared with the greater educational community, teachers change teaching of mathematics.

This study is based on teachers' careers, their perspective on their development in mathematics teaching, and their history in teaching mathematics. It is not an evaluation of whether teachers are teaching in accordance with this or that recommendation for the classroom. It is also not a judgment of the teachers' implementation of reform rhetoric. With this approach to the study of teachers' practices and change, it is quite striking to notice to the many changes teachers are making in their practices.

The history of Helen's professional career in no way resembles the image of teaching as a job in which changes seldom occur. Quite the contrary, listening to Helen's stories, one becomes immersed in change, new experiences and searches for professional growth. Helen's ongoing quest for new ideas, together with changes in working milieu and new educational trends, have led her onto a path of many revisions and alterations of her teaching practice. From Helen's point of view, change is not a slow, difficult process; change is a necessary component of good mathematics teaching, it is part of teachers' everyday experiences.

The difference between the two perspectives on mathematics teachers' practice—one more static and one more dynamic—deserves attention. One way to approach this difference is to take into account the idea that researchers and teachers may have different perspectives on classroom practices (Simon & Tzur, 1999) and different meaning for what counts as change. Many researchers have an ideal image of what should constitute mathematics teaching. With this image as a starting point, it becomes hard to observe change—probably because the changes required to become like the envisioned, ideal teacher are too big. Also, researchers are typically looking for profound changes that affect teachers' practice in all of its dimensions. These changes are probably less often, and represent turning points in teachers careers. Finally, researchers focus their studies on particular points in time, looking at teachers during specific moments of their careers. Loosing a career perspective might make it harder to detect changes.

Teachers, on the other hand, understand change in a way that is more in tune with their step by step, everyday attempts to improve teaching. From this perspective, changes become a long-term and a short-term process at the same time. It is about everyday life in the classroom as well as about opportunities that appear throughout one's career. Change, from teachers' perspectives can be about trying new ideas, changing the way a certain lesson is structured, changing the books used for the introduction of a certain topic, adding a new assignment to their syllabus. In the case of very experienced teachers, the vision of change is strengthened by the privilege of exploring it from a 30-year perspective.

When researchers approach teachers with a static perspective of mathematics teaching, they fail to capture the many changes teachers implement in their daily practices and in the paths of their careers. They also fail to notice the many ways in which research recommendations for change might be reaching the classrooms, and the ways in which the mathematics education reform rhetoric circulate within schools. Not understanding teachers from their own perspectives, one might not recognize small steps toward change as important components in the development of mathematics teachers. In this case, teachers on-going development and growth goes unnoticed.

It is time we better understand teachers and their mathematics teaching. There are many questions to be answered, some of which related to the issue of change in mathematics teaching practice. It is worthwhile to notice that, as Helen puts it, teachers learn from each other. In schools where many teachers are searching for new ideas for improving elementary school mathematics teaching, transformation and growth might gain bigger momentum and happen in an easier, quicker fashion. Studying teachers who work such schools might allow us to improve our understanding of mathematics teaching and change.

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