

EXPLORING PHILOSOPHY DURING A TIME OF REFORM IN MATHEMATICS EDUCATION

Students engaged in reasoning and critical thinking while completing worthwhile mathematical tasks, exploring multiple pathways toward the solution of complex, real-world problems. This is the vision of mathematics teaching and learning that forms the foundation of the Common Core State Standards for Mathematics. Unfortunately, despite over twenty years of reform in mathematics education, this problem-based, student-centered mathematics classroom continues to elude many teachers and students.

Many K-12 teachers continue to teach mathematics in the same manner in which they were taught (Gates, 2006). Mathematics is often seen as a rote exercise requiring the memorization of numerous formulas that are then used to complete meaningless problems with little or no connection to the real world. But the implementation of the Common Core State Standards will require a monumental change in how mathematics is taught in the United States. The Common Core curriculum, now adopted in 45 states, shares a vision with the National Council for Teachers of Mathematics of mathematics as an active, relevant subject (NCTM, 1989, 2000). The Standards for Mathematical Practice, an essential element in the Common Core State Standards for Mathematics, highlight the importance of problem solving, modeling, reasoning, critical thinking, and communication in the classroom.

Why are teachers reluctant to change how they teach mathematics? Research cites various reasons, including the lack of professional development in a new curriculum, a deficiency in the depth of understanding of the mathematics, and the absence of appropriate role models (see e.g., Hart, 2002; Mewborn, 2002; Sztajn, 2003). In order to implement the Common Core curriculum fully, including the Standards for Mathematical Practice, states and local school systems must, and often have, addressed each of these issues. But the philosophy of mathematics, particularly school mathematics, is an essential area in the teaching and learning of mathematics that has too often been ignored in the reform

movement. Instructional change may continue to elude us until we address philosophy explicitly. What is the purpose of mathematics? Why do we teach mathematics in our schools?

In this presentation, I will discuss a study that focused on philosophy of mathematics during the implementation of a reform curriculum in mathematics. This presentation will provide an overview of the study and a discussion of the importance of this research during the current implementation of the Common Core State Standards for Mathematics. The study and its findings have implications for teacher educators, professional development leaders, and other teacher leaders in the field of mathematics education. Ideas for future research that builds on this topic will also be discussed.

The purpose of this study was to examine the processes that educators go through as they formulate a personal philosophy of mathematics at a moment in time when they were also engaged in implementing a new, task-based mathematics curriculum. Two questions guided the study: (1) How do teachers define their personal philosophies of mathematics teaching and learning? (2) As teachers explore humanist/fallibilist philosophies of mathematics, how do their perceptions of mathematics and mathematics teaching and learning change?

The four participants in this study were full-time mathematics educators, working as classroom teachers and instructional coaches. The educators were also part of a graduate-level mathematics education course that examined, through the writings of Davis and Hersh (1981), Lakatos (1976), Polya (1945/1973), and others, a humanist/fallibilist philosophy of mathematics. Subsequent data collection occurred as the educators were immersed in the state-wide implementation of a reform mathematics curriculum, a curriculum based in social constructivist theories. Data was collected through course assignments, class discussions, and extensive interviews with each participant. Using narrative analysis, the study focused on the unique mathematical story of each of these experienced educators, examining how those stories changed and developed as the participants struggled to adapt their instructional practices or influence the instructional practices of those around them.

Narrative analysis allows for the systemic study of personal experience and meaning (Riessman, 2002) by exploring stories on multiple occasions, through multiple sources. The use of journals, reflective essays, and extended interviews throughout an 18-month period, provided the rich data that was necessary to understand these teachers' stories, and to explore their changing perceptions of mathematics, and mathematics teaching and learning. Narrative analysis aligns with a social constructivist paradigm of learning (Hendry, 2007), acknowledging the contextual and contradictory nature of professional growth and development. Narrative analysis allows the researcher to more closely follow the ebb and flow of teacher change, and the journey of our participants, emphasizing process rather than product.

This study posits the necessity of a philosophy of mathematics, for a teacher's perceptions and beliefs about mathematics have a great deal to do with how that subject is then characterized in classroom teaching and learning (Dossey, 1992). Each of the participants of the study initially expressed a traditional, a priori view of mathematics, seeing mathematics as right/wrong, black/white, a subject outside of human construction. In fact, several of the educators were first drawn to the teaching of mathematics for these very reasons: the pride in conquering a difficult, abstract subject, or the beauty of solving and simplifying a lengthy algebraic equation.

The participants' expressed views of mathematics changed as they attempted to align their personal philosophies with their (changing) classroom practices. The humanist/fallibilist view of mathematics explored in the graduate-level course readings started to make sense as they engaged in a reform curriculum that focused on reasoning, problem-solving, and communication. The teachers began to redefine their personal philosophies of mathematics, to demystify the mathematics, and even to engage their students in an exploration of the philosophy of mathematics.

What is mathematics? Is mathematics a body of knowledge consisting of formulas, memorization, and rote calculations, or should we engage learners of mathematics in personal sense-making, in constructing their own mathematical understandings? The answers to these questions that

will have an enormous impact on how a teacher engages his or her students in the study of mathematics. If we continue to ignore the question of philosophy in our reform efforts, we will continue to bypass true reform in the education of our young people. Too many teachers and students view mathematics as a disconnected subject – disconnected from our students' lives, disconnected from practical use and understanding, disconnected from the real world. Both in-service and pre-service teachers should engage in an exploration of philosophy of mathematics, at an academic and personal level, and examine how those philosophies intersect with their philosophy of teaching and learning. By exploring their own personal mathematical histories and putting words to their personal philosophy of mathematics, teachers may well find that their perceptions of mathematics and mathematics education do not align with the expectations of teaching mathematics in the constructivist-based reform classroom.

Discussions of philosophy, particularly philosophy of mathematics, should be brought to the forefront of mathematics education reform. Teachers will continue to resist change and to teach the way they were taught, if they are never asked to explore the philosophical basis of their perceptions of mathematics. Teachers involved in curriculum reform must be made aware that mathematics is not a static subject, that its transcendental nature has been questioned, and that seeing mathematics as a human construct may allow us to integrate constructivist instruction more easily into the mathematics classroom.

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