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The Role of History in a Mathematics Class

Over the last five years, interest in the role of history in teaching mathematics has grown markedly. A National Science Foundation–supported Mathematical Association of America Institute on the History of Mathematics and Its Use in Teaching was founded in summer 1995 to explore how the history of mathematics can be used in the classroom. It has produced modules for use in high school and college mathematics teaching. A study on this topic has been authorized by the International Commission on Mathematics Instruction and was the centerpiece of the most recent International Congress in Mathematics Education (ICME), which was held in Japan in the year 2000.

In April 1997, the American section of the International Study Group on the Relations between History and Pedagogy of Mathematics (HPM) met in Minneapolis to discuss the role of the history of mathematics in teaching and learning mathematics. The purpose of HPM is to promote the use of mathematics history to instruct and motivate students. In June 1997, a short course on the history of mathematics was held at the University of Iceland in Reykjavik. Iceland is adopting the same curricular solutions as Denmark and Norway and is incorporating positive support for history within the teaching framework.

A program that used items from the history of mathematics was effective in promoting positive attitudes

The government of Denmark has recently decided that the history of mathematics must be included in mathematics courses in the upper grades. Danish students must learn the elements of the history of mathematics and the role of mathematics in connection with culture and society. In *Vita Mathematica,* Rickey (1996) argues that history must be included in teaching mathematics. He recounts how historical remarks made by two of his teachers helped him understand the material better and see how it fit into the wider domain of mathematics.

LIMITED RESEARCH

An electronic search of the Educational Resources Information Center (ERIC) and *Dissertation Abstracts International* uncovered only three empirical research studies that discuss the use of history to teach mathematics. Two of the studies were quantitative, and the other one was qualitative.

In 1977, McBride and Rollins observed the effects of studying mathematics history on attitudes of college algebra students toward mathematics. Sixty-seven students participated in an experimental study in which half were exposed to five-minute vignettes on the history of mathematics in standard algebra courses. The Revised Math Attitude Scale (RMAS) was administered at the beginning and at the end of the twelve-week quarter. A significant difference in attitude change was found. The program that used items from the history of mathematics was effective in promoting positive student attitudes toward mathematics.

Jardine (1997) actively engaged West Point cadets in learning mathematics by involving them in studying the history of mathematics in calculus courses. Eighty-four students researched a historical figure or concept, made a three- to five-minute oral presentation to the class, and submitted a one-page essay. Students completed an anonymous researcher-prepared survey at the end of the term. The students reported that the historical work motivated them to learn mathematics. Actively engaging students in learning mathematics history qualitatively enhanced the learning experience for them.

Furinghetti (1997) used case studies to investigate outcomes of linking mathematics history, mathematics education, and school practices. An analysis of the work in four teachers' classrooms led to the insights that he presented. When students were engaged in personal research on the history of mathematics, one teacher found that the exercise was a good way to elicit hidden beliefs and conceptions. Another teacher used historical problems to motivate students who were not interested in mathematics. A third teacher used history, instead of traditional numerical computation, as an optional activity. To approach concepts differently, the fourth teacher employed the use of history. Furinghetti

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concluded that history in mathematics facilitates understanding through reflection and enhances mental imaging by expanding a student's conception of mathematics. He noted that activating a different frame of reference for tackling problems reinforces students' flexibility.

Although no empirical evidence demonstrates that attention to history advances the learning of middle and high school students, the previously cited research does argue in favor of using history in mathematics classes. Educators believe that it tends to enrich the teaching and learning of mathematics in a variety of ways. Additional research is needed to validate the many claims made in opinion-based articles.

OPINIONS

The NCTM's *Curriculum and Evaluation Standards for School Mathematics* (1989) and *Principles and Standards for School Mathematics* (2000) call for reform in mathematics teaching and learning. Many professionals have promoted using mathematics history in the mathematics classroom as one way to facilitate this reform. Scriba (1975) states that the history of mathematics can be used to overcome the difficulties that many students encounter when beginning to study mathematics. Students should read books and report about mathematicians. A look at historical materials can prompt teachers and students to think and talk about mathematics (Van Maanen 1997).

Bidwell (1993) notes that history can promote communicating, connecting, and valuing mathematics. Much of what we do in mathematics can be explained by giving a historical context. We need to obtain and communicate mathematical understanding. One way to accomplish this goal is by using original sources, mathematics history, and writing assignments in teaching mathematics (Darrow 1997).

Swetz (1995) believes that history can supply the why, where, and how for the many concepts that are studied. Many universities need to develop a history-of-mathematics course for prospective and current mathematics teachers (Bell 1992).

Teaching for meaning and understanding is a primary goal of the reform movement. For a complete understanding, mathematics must be considered in the context of the time and place in which it developed (Sawyer 1997). The aim is to discover the ways in which using mathematics history makes learning more comprehensive for students. Jones (1989) reports that we need to be teaching so that children see and appreciate the nature, role, and fascination of mathematics; so that students know that people are still creating mathematics; and so that students can also have the thrill of discovery and invention.

Mathematics is dynamic and constantly evolving. History teaches that observation, analogy, induction, and intuition are the initial and often the most natural ways to acquire mathematical knowledge (Kleiner 1988). One method that integrates critical reasoning and cultural history is using games of strategy (Gorman 1997). Historical games help teachers create units that exemplify the NCTM's Standards by developing strategies instead of teaching rote rules. Such an activity helps students improve their critical-thinking skills and understand the interconnectedness of our diverse human history.

Bos (1976) surmises that reporting on books and writing reports about topics in mathematics history can give students the excitement of independent discovery. Studying the history of any particular topic in the curriculum often leads to many valuable pedagogic ideas. Such study not only helps students understand the development of the subject but also gives them ways to connect mathematics and other aspects of civilization (Katz 1986).

Mathematical developments in other cultures follow different tracks of intellectual inquiry (D'Ambrosio 1997). An ethnographic approach to the history of mathematics aids a student's understanding and opens the door to an in-depth study of ethnomathematics. This approach requires and supplies a greater range of connections in the student's mind.

Other creative ways of using history in mathematics teaching include biographies and plays. Voolich (1993) contends that incorporating biographies of mathematicians can successfully bring the human story into the mathematics classroom. A historical play can furnish a human and intellectual background to the subject of mathematics (Hitchcock 1997).

History expands a student's conception of mathematics

VIGNETTE

Using history in teaching and learning mathematics can be encouraged and facilitated by taking advantage of information on the World Wide Web. We undertook a project in spring 1999 to accomplish the following tasks:

- We sought to identify and describe, from a mathematics instructor's viewpoint, the best free online resources that could help in including history in the mathematics classroom.
- In the Illinois State University (ISU) mathematics department, we established a Web page **(www.2.math.ilstu.edu/~marshall/)** that contains this information in capsule form, as well as hyperlinks to these sites.

The Web site at ISU that promotes using history in mathematics classrooms has been available only for a short while but has already been a valuable

resource to mathematics instructors. Julie Lescaut, who works with gifted eighth graders at Grant Middle School and Franklin Middle School in Springfield, Illinois, is one such teacher. Twenty-eight of her students went online and accessed this site to complete special projects that involved mathematics history. Some of her students developed books for first graders that contained information about, and pictures of, famous mathematicians. Others constructed alphabet books of mathematics by identifying a topic or a mathematician for each letter of the alphabet. They explained topics and highlighted major contributions of mathematicians. At least two students found a mathematician for each of the twenty-six letters of the alphabet.

History shows that mathematics is the creation of human beings

The ISU Web site was used as a springboard to some of the best history-of-mathematics information on the Internet. Lescaut remarked that having a place for her students to begin their research was nice. The Web site was an easy way to launch the students' projects because it offered easy access to a large variety of Web pages on the history of mathematics. It allowed people to explore the worldwide resources in a short time. Lescaut stated that her students really liked working on the Internet. They found it enjoyable, challenging, and educational.

To sum up, history has a vital role to play in today's mathematics classrooms. It allows students and teachers to think and talk about mathematics in meaningful ways. It demythologizes mathematics by showing that it is the creation of human beings. History enriches the mathematics curriculum. It deepens the values and broadens the knowledge that students construct in mathematics class.

REFERENCES

Bell, John G. "A History of Mathematics Class for Middle School Teachers." (Doctoral diss., Illinois State University, 1992.) *Dissertation Abstracts International* 53 (1992): (Accession No. AAG9234458).

Bidwell, James K. "Humanize Your Classroom with the History of Mathematics." *Mathematics Teacher* 86 (September 1993): 461–64.

Bos, Henk J. M. "History of Mathematics in the Mathematics Curriculum at Utrecht University." *Historia Mathematica* 3 (March 1976): 473–76.

D'Ambrosio, Ubiratan. "Where Does Ethnomathematics Stand Nowadays?" *For the Learning of Mathematics* 17 (June 1997): 13–17.

Darrow, Jeffery R. "Revitalizing the Curriculum: Using Original Sources, History, and Writing in Undergraduate Mathematics." (Doctoral diss., Idaho State University, 1997.) *Dissertation Abstracts International* 58 (1997): 5A (Accession No. AAG9734214).

Furinghetti, Fulva. "History of Mathematics, Mathematics Education, School Practice: Case Studies in Linking Different Domains." *For the Learning of Mathematics* 17 (February 1997): 55–61.

Gorman, Jacqueline. "Strategy Games: Treasures from Ancient Times." *Mathematics Teaching in the Middle School* 3 (October 1997): 110–16.

Hitchcock, Gavin. "Teaching the Negatives, 1870–1970: A Medley of Models." *For the Learning of Mathematics* 17 (February 1997): 17–25.

Jardine, Richard. "Active Learning Mathematics History." *Primus* 7 (June 1997): 115–21.

Jones, Phillip S. "The History of Mathematics as a Teaching Tool." In *Historical Topics for the Mathematics Classroom*, pp. 1–17. Reston, Va.: National Council of Teachers of Mathematics, 1989.

Katz, Victor J. "Using History in Teaching Mathematics." *For the Learning of Mathematics* 6 (November 1986): 13–19.

Kleiner, Israel. "Thinking the Unthinkable: The Story of the Complex Numbers (with a Moral)." *Mathematics Teacher* 81 (October 1988): 583–92.

McBride, Cecil C., and James H. Rollins. "The Effects of History of Mathematics on Attitudes toward Mathematics of College Algebra Students." *Journal for Research in Mathematics Education* 1 (January 1977): 57–61.

National Council of Teachers of Mathematics (NCTM). *Curriculum and Evaluation Standards for School Mathematics*. Reston, Va.: NCTM, 1989.

———. *Principles and Standards for School Mathematics*. Reston, Va.: NCTM, 2000.

Rickey, V. Frederick. "The Necessity of History in Teaching Mathematics." In *Vita Mathematica: Historical Research and Integration with Teaching*, edited by Ronald Calinger, pp. 251–60. Washington, D.C.: Mathematical Association of America, 1996.

Sawyer, Warwick. "Mathematics in History." *Mathematics in School* 26 (May 1997): 2–3.

Scriba, Christoph J. "The Place and Function of a 'Historical Introduction' in the Curriculum for Mathematics Students." *Historia Mathematica* 2 (April 1975): 322–31.

Swetz, Frank. "Some Not So Random Thoughts about the History of Mathematics—Its Teaching, Learning, and Textbooks." *Primus* 5 (June 1995): 97–107.

Van Maanen, Jan A. "New Maths May Profit from Old Methods." *For the Learning of Mathematics* 17 (June 1997): 39–46.

Voolich, Erica Dakin. "Using Biographies to 'Humanize' the Mathematics Class." *Arithmetic Teacher* 41 (September 1993): 16–19.