

Who? How? What? A Strategy for Using History to Teach Mathematics

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Patricia S. Wilson and Jennifer B. Chauvot

Who? How? *What?*

A Strategy for Using History to Teach Mathematics

In classrooms, we often treat mathematics as if we were learning on an island. We travel to that island once a day for mathematics and delve into a study that is pure, clean, and logically solid and has clear lines and no dirty corners. Students think that mathematics is closed, dead, emotionless, all discovered. . . . By including [the history of mathematics], we can rescue students from the island of mathematics and relocate them on the mainland of life that contains mathematics that is open, alive, full of emotion, and always interesting.

—Bidwell (1993, p. 461)

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Bidwell raised the issue of isolated mathematics, which is a concern for many mathematics teachers. Incorporating history in mathematics lessons can help students make connections and much more. Many teachers advocate including the history of mathematics in their lessons but wisely protest against adding more courses or topics into an already crowded curriculum. We argue that integrating history into the mathematics curriculum is a judicious way to teach mathematics. Rather than become an additional task, it can be a tool for effective teaching. We first explain some of the benefits of integrating history and mathematics and then propose a specific strategy for integrating history into mathematics lessons.

BENEFITS OF INTEGRATING HISTORY AND MATHEMATICS INSTRUCTION

In synthesizing advice from teachers, mathematics historians, mathematics educators, and preservice teachers, we identified four essential benefits. Inte-

grating history and mathematics instruction sharpens problem-solving skills, lays a foundation for better understanding, helps students make mathematical connections, and highlights the interaction between mathematics and society.

Mathematics history is an excellent source of interesting problems that supply opportunities to sharpen problem-solving skills (Swetz 1986). History offers diverse approaches, as well as a variety of algorithms and techniques for solving similar problems that allow students to develop such skills as considering multiple strategies and evaluating both solutions and procedures. Using historical problems in instruction can bring up related problems, thereby stimulating further mathematical explorations and discussions.

Using history in mathematics instruction can also contribute to students' understanding of concepts. In response to a survey, one teacher explained that history "can make a topic more accessible to students." History can also tell the origins of particular ideas and procedures. Another teacher explained, "I believe it [history] is relevant because students need to see the big picture. They need to know more than 'Here's Pascal's triangle'; they need to know where it comes from and why, and how does it tie into other things." Bidwell (1993) described this contribution as explaining the "whys" in mathematics. Furnishing a historical perspective of the development of mathematical concepts establishes a foundation for better understanding.

The ability to make mathematical connections has been emphasized by teachers, employers, and the NCTM's *Principles and Standards for School Mathematics* (2000) as one of the most important

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goals of mathematics learning. History is replete with mathematical connections—connections between mathematical topics, connections between mathematics and applications, connections between mathematics and other disciplines. In addition, history is full of mathematical connections across centuries, cultures, and regions of the globe. Several teachers identified with Bidwell's description of learning mathematics on an island. One teacher made the following comment:

I think many of us treat our classrooms like mathematics islands. We throw all the math stuff we can on our walls and bulletin boards. We talk math, think math, and do math, but as far as the students are concerned, it's probably one hour a day and then homework. Our goal is to get students to see how mathematics relates to everything. Mathematics is not an island but a major piece of fabric that represents all of our lives.

Using history lends itself naturally to connecting mathematics with other disciplines when the focus is on how mathematics has influenced world history, science, economics, inventions, art, and communications (Bidwell 1993; Fauvel 1991).

Students are often not aware of the interaction between mathematics and society. The interaction is a two-way street where, in one direction, the norms and practices of various cultures influence mathematics, whereas in the other direction, mathematics influences the ways that people operate in, and think about, the world. In Egypt, the pharaohs' desires for elaborate tombs stimulated the development of the mathematics needed to build the Great Pyramids. In 1957, the launch of Sputnik and the ensuing space race stimulated funding, research, and education in mathematics.

Sometimes societies have placed limits on mathematics. Political and religious doctrine interrupted the works of Galileo, Descartes, and Einstein. In the late 1800s, Russia's policy of not allowing women to study or teach mathematics at universities forced Sonya Kovalsky to leave Russia to study in Germany. Even in Germany, she could not officially attend classes. We cannot know what dimensions of mathematics may have been lost as a result of societal influence.

In the other direction, mathematics has changed society by contributing theories, models, and algorithms, resulting in new information systems, ways of communicating, and exploration of our universe. Unfortunately, mathematics has even served as a screening device for participation in scholarly pursuits. From the secret Pythagorean society of ancient times to college admission today, mathematical knowledge creates privileges.

When we teach mathematics, we make an explicit or implicit statement about the discipline of mathematics. We very explicitly say that mathematics includes the study of patterns, deductive

reasoning, efficient algorithms, and problem-solving strategies, but we may be misleading students with what is not said. Do we focus on the elegant proof and exclude the hundreds of years of inductive thinking that led to the proof? Do we ascribe specific mathematics to a particular person—for example, Pascal's triangle, the Pythagorean theorem, or Euclidean geometry—without attributing equivalent or related work to other men and women? Do we assign more value to mathematics found in a book than to mathematics found in practical wisdom? When we teach mathematics, we are teaching the nature of mathematics. A historical perspective can help students see mathematics as powerful, accessible, connected, and evolving.

A STRATEGY FOR INTEGRATING HISTORY INTO MATHEMATICS LESSONS

Of course, finding ways to integrate history and mathematics is the challenge for teachers. Fauvel argues that we must go beyond understanding the contributions of history and address how we might incorporate history. He points out that using history in mathematics instruction is not a simple task; history is not an additive that "can just be poured in at the right time, like fabric conditioner into one's washing machine" (1991, p. 4). As one teacher explained, "Yes! . . . The history of mathematics is much more than trivia. . . . However, it's not really as easy as it may seem. I have had a hard time coming up with ways to use the history of mathematics in a nontrivial way." We believe that knowledge and expertise are necessary to use history effectively in instruction, but this expertise is best developed through experience.

In an effort to resolve the get-started-versus-delay-until-expert dilemma, we offer a strategy for helping teachers at any level use history in their classrooms. Our strategy is to address three questions that supply the links for connecting, understanding, and enjoying mathematics and ultimately for broadening views about the nature of mathematics. We want students and teachers to think about *who* does mathematics, *how* mathematics is done, and *what* mathematics is. History gives us different answers to these questions, depending on when, where, and in what context we are looking. In other words, history furnishes the human story of creating mathematics.

Although good materials and a good plan are essential to an effective lesson, the mathematical goals of the lesson drive the way that the materials and plan are used. Having goals related to what students will learn about mathematics is just as important as having goals related to specific mathematical skills and processes. Teachers supply motivation, information, direction, and opportunity, but



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students learn more about mathematics when they approach these questions for themselves.

Who does mathematics?

We know that many students perceive mathematics as a discipline that is done by others rather than people like themselves. The “others” may be the smartest students (Oakes 1990), boys (Meyer and Koehler 1990), or specific ethnic groups (Moody 1997). Often school mathematics is attributed to contributions by Europeans, whereas contributions by other cultures are “ignored, devalued, or distorted” (Joseph 1990, p. 3).

The way that mathematical ideas are shared also influences our perceptions of who does mathematics. Historians know about Babylonian and Egyptian mathematics through artifacts that have been found. The Babylonians recorded mathematics on clay tablets that were sturdy enough to endure the elements over time, and the arid climate of Egypt helped preserve the papyri. Some cultures shared knowledge orally and left no tangible record. Suggesting that a particular culture or time period did not engage in mathematics is unwise because we may have not yet found or looked for such artifacts. A conscientious account of the history of mathematics more accurately traces the origins of ideas to a variety of early civilizations, acknowledges current mathematicians, includes women, and explains the contributions of many cultures.

How is mathematics done?

Many of the mathematicians discussed in school textbooks did not consider themselves to be mathematicians. They were astronomers, explorers, inventors, philosophers, religious leaders, and businesspeople who used the tools of their professions to do mathematics. Not only have the tools of mathematics changed across centuries and cultures, the tools have changed mathematics. The computers and calculators of today allow us to calculate faster and more accurately than in the past, but more important, they offer opportunities to think about mathematics differently by using spreadsheets, graphing relationships, and investigating dynamic geometric components.

Through history, we can see how different numeration and symbolic systems have facilitated or restricted advancement in certain areas of mathematics. Numeration systems with place value, such as the Hindu-Arabic system, have several computational advantages over such systems as roman numerals. Today we rely on conventional variables and symbols to pose algebraic problems. The ancient Hindus used elaborate stories, and the ancient Greeks relied on geometric interpretations as they worked in sand tables. Each method of

doing mathematics made a difference in how the mathematics was viewed.

What is mathematics?

History gives us a way to view mathematics as not only a combination of such mathematical topics as quadratics, functions, spherical geometry, and logic but also a human endeavor that has spanned centuries and cultures. History shows that mathematics has been perceived differently by various communities. *Who* does the mathematics and *how* it is done influence *what* is considered to be mathematics.

History reminds us of the varied faces of mathematics. It has been seen as beautiful by those who found patterns in geometry and numerical systems. Mathematics was the essence of Bach’s music, Escher’s art, and Gödel’s reasoning. Mathematics has also been viewed as useful in accomplishing the daily tasks of living and working. Bishop (1988) explains that all cultures share such mathematical tasks as counting, locating, measuring, designing, playing, and explaining. Ethnomathematics documents the mathematics that is created and used by people every day. In contrast, some people view mathematics as abstract ideas that are used to create or communicate theories. For example, mathematics provides a way to visualize n -dimensional space, fractals, and logic. Although it serves as a precise language connecting the sciences, Steen (1988, p. 611) notes that often the “steep and harsh terrain of abstract language” separates mathematics from ordinary human activity. History gives us ways to introduce students to the beauty, utility, and abstraction of mathematics. It can help students tackle the steep terrain and expand their views.

The potential of the history of mathematics to enhance mathematics learning and teaching is widely acknowledged, but concerns and cautions often delay getting started. We have offered a strategy that can help teachers and students begin using the history of mathematics as they learn more about both history and mathematics. By considering the who, how, and what of mathematics, creative teachers can use historical mathematical information both to foster insights into the mathematics in their existing curriculum and to help students understand the nature of a continuously evolving mathematics that is the heritage of every student. History illustrates that mathematics is powerful, accessible, connected with each of us, and still evolving.

Helpful resources in addition to the references listed can be obtained by sending an e-mail to the authors at pwilson@coe.uga.edu or jchauvot@coe.uga.edu.

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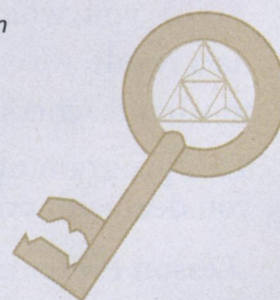
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