

Introduction

Using the history of mathematics to motivate interest and understanding in the mathematics classroom has become an acknowledged pedagogical option for mathematics instructors. The knowledge base on how to incorporate history into the classroom has grown by leaps and bounds in the last few decades. A look at the number of recent books published by many academic publishers, to include the MAA, is indicative of this effort to improve mathematics teaching and learning.

However, due to the nature of mathematical advances in the last few centuries, the history of topics such as logic and Galois theory are much less accessible. The level of mathematical sophistication needed to grasp these topics, even at an introductory level, is much higher than that needed for most older subjects. Given that the development of a subject is usually harder to follow than the final theory, the history of more recent topics may be even harder to comprehend. For exactly these reasons, it is important to present the historical evolution of and motivation for these topics. Many higher-level concepts seem remote and arbitrary to students. Presenting the historical development of these more recent and advanced topics gives the students the connections needed to gain a deeper understanding of higher mathematics.

This volume is intended to be a resource for undergraduate mathematics teachers, providing ideas and materials for immediate adoption and proven examples to motivate innovation by the reader. The book is divided into sections by subject area to make it easier for teachers to find a relevant article for a course they have in mind.

Section One focuses on courses commonly found in the undergraduate mathematics core and elective courses: calculus, abstract algebra, numerical methods and number theory. David Pengelley uses a seminal paper by Cayley to motivate student learning in an abstract algebra course. Bob Rogers offers activities which utilize the differential to solve calculus problems, an alternative approach to motivate students' geometric and historical insights. Matt Lunsford's contribution answers the question: How can the ideas of Evariste Galois enhance the teaching of undergraduate abstract algebra? The study of elliptic curves relates algebra and geometry, and Lawrence D'Antonio ties together those concepts in describing some deep and current mathematics in a way accessible to upper-level undergraduate students. Through a presentation of the historical development of predator-prey models, Holly Hirst provides activities to ensure that students understand that mathematical modeling is an evolving process.

Section Two contains articles on the subject of geometry. Jeff Johannes relates how advances in that subject area dispelled fears of prominent mathematicians of the late eighteenth century that the future of mathematics was bleak since all the work was done and no new great minds were apparent to carry on the mathematical tradition. Daina Taimina and David W. Henderson integrate the history of mathematics in undergraduate geometry instruction and include historical presentation of non-Euclidean geometries. Eisso Atzema and Homer White survey a few of Euler's late geometrical papers and offer ideas for exercises in a geometry class or problems for investigation by students.

Section Three includes additional topics found in other courses of the undergraduate mathematics curriculum, to include statistics and the mathematics of computation. Dick Jardine offers the use of historically based projects to engage students and deepen their learning of numerical analysis topics. For

instructors of a course in logic for undergraduate mathematics or computer science majors, Francine Abeles provides a paper for those who wish to include an historical approach to the significant developments of modern logic. In a similar vein, William Calhoun connects logic and computing to motivate both mathematics and computer science majors in discrete mathematics and theory of computation courses. Linda McGuire describes important issues concerning semester-long research projects given in an upper division combinatorics and graph theory class. The mathematics of cryptography has growing interest among our students, and Shai Simonson writes about classroom activities that work for him, his colleagues, and his students in discrete mathematics and number theory courses. Patti Hunter uses a historical perspective to address the controversy of just how much rigor to include in undergraduate statistics courses. Jerry Lodder offers ideas for implementing the history of logic and programming into computer science courses.

Section Four addresses some issues relevant to the history of mathematics and methods for conducting a history of mathematics course, to include those courses targeted at pre-service school teachers. Sarah Greenwald notes that students identify more readily with current mathematicians, and she offers ideas to include projects involving the history of current mathematicians, with examples of women and minority practitioners. Dave Roberts offers mathematical topics from a history of science course that would apply to portions of a history of mathematics course, relating the interconnection between mathematics and other disciplines. Amy Shell-Gellasch “personalizes” the history of mathematics course by suggesting ways to include the history of one’s own institution as a significant component. The protractor is an oft-used tool in middle and secondary education; Amy Ackerberg-Hastings outlines the historical development of that instructional tool. A history of the slow acceptance of the metric system in American mathematics education is given by Peggy Kidwell. Peter Ross offers some ideas to spark interest and discussion and to motivate student interest in the history of mathematics. John Prather concludes the volume with a description of a problem-solving approach to the history of mathematics in a course intended for pre-service middle and secondary teachers.

This collection, then, is an eclectic mix of ideas expressed by colleagues with interests similar to ours: the improvement of mathematics education through the use of the history of mathematics. There are other references more definitive on the specific mathematical topics addressed, and we invite the reader to take advantage of those available from the MAA collection and their local college and university library. We hope the reader will be inspired to apply the history of mathematics for the betterment of teaching and learning, and then share the experience with the mathematics community.