Chapter 14
Interactive Web-Based Tools for Learning Mathematics: Best Practices

Barry Cherkas[1]
Hunter College of the City University of New York, USA

Rachael M. Welder
Hunter College of the City University of New York, USA

ABSTRACT

There is an abundance of Web-based resources designed for mathematics teachers and learners at every level. Some of these are static, while others are interactive or dynamic, giving mathematics learners opportunities to develop visualization skills, explore mathematical concepts, and obtain solutions to self-selected problems. Research into the efficacy of online mathematics demonstrations and interactive resources is lacking, but it is clear that not all online resources are equal from a pedagogical viewpoint. In this chapter, a number of popular and relevant websites for collegiate mathematics and collegiate preservice teacher education are examined. They are reviewed and investigated in terms of their interactivity, dynamic capabilities, pedagogical strengths and weaknesses, the practices they employ, and their potential to enhance mathematical learning both inside and outside of the collegiate classroom. Culled from these reviews is a working definition of "best practices": condensing difficult mathematical concepts into representations and models that clarify ideas with minimal words, thereby enabling a typical student to grasp, quickly and easily, the underlying mathematics.

DOI: 10.4018/978-1-60960-875-0.ch014

INTRODUCTION

The development of the Internet has provided mathematics teachers and educators at all levels with a wealth of information and a plethora of resources that were not previously available. Through this vast medium, myriad web-based materials that aim to enhance the teaching and learning of mathematics are continuously being developed. Some web-based resources are **static**, meaning that knowledge-seekers read passive content published on a website similar to material printed in a textbook. Other resources, however, are **interactive**, having the ability to provide the learner with a richer learning experience. Unfortunately though, many interactive websites do not actually teach students *how* to solve problems; instead, they deliver solutions not unlike an answer key, which can be useful for checking homework but not for developing knowledge or actively nurturing learning. On the other hand, some interactive websites are **dynamic** (Wikipedia, 2010), meaning that knowledge-seekers interact with web tools that generate fresh customized content based on user input. Interactivity is a major advance in delivering mathematics education with the power to reform the teaching and learning of mathematics.

The purpose of this chapter is to provide an overview of selected dynamic and potentially dynamic, interactive web-based mathematics resources to help readers identify effective practices for collegiate mathematics education. While there is a growing literature that studies classroom and assessment applications of technology [see e.g. Computer Algebra in Mathematics Education (2010)], we do not review or advocate any particular classroom or curriculum usage of the websites reviewed here. Instead, our goal is to expose college mathematics instructors to a variety of interactive and dynamic websites, for integration into the courses they teach, whether online or face-to-face. Furthermore, through our reviews, we aim to help college instructors develop a pedagogical view of the offerings and limitations of online tools, guiding them in their selection and evaluation of both existing websites and those yet to be developed. Since websites that aim to enhance learning in mathematics are continuing to evolve, it is important that educators are capable of identifying educationally sound web-based practices when selecting online resources for teaching and research purposes.

We have analyzed a number of highly ranked, interactive and dynamic web-based resources, relevant for collegiate mathematics education. In this chapter, we review a sample of select websites and discuss the effectiveness of the practices they employ, their pedagogical strengths and weaknesses, and their potential to enhance mathematics learning, in ways of which printed (and static) materials are not capable. We first address web-based resources that are appropriate for teaching and learning college level mathematics content. In this section, we discuss online resources based on the degree of user interaction and engagement required, starting with animations, followed by interactive tools, and ending with dynamic tools. The tools in this section cover mathematical material ranging from college algebra through calculus; so, in addition to addressing collegiate mathematics, many of the tools would also be appropriate for undergraduate courses designed for preservice secondary mathematics teachers. Afterwards, we address interactive and dynamic online resources relevant to the mathematical development of undergraduate preservice elementary and middle school teachers.

BACKGROUND

Types of Web-Based Resources

Many web-based resources are static, meaning that knowledge-seekers read passive content published on a website similar to material printed in a textbook. Some resources, however, are interactive,