Best Internet Practices for Secondary Mathematics

Melissa Scranton (middle)
Dianna Galante (right)
Patricia Nugent (left)
Illinois State University

One of the greatest opportunities and challenges for educators in recent years has been the introduction of the Internet into the classroom. The Internet has revolutionized the way mathematics can be discussed, taught and explored (Klotz, 1997). However, many teachers who have tried to integrate the Internet into their classrooms have been confronted by the enormity of what’s available online, the difficulty sorting through this vast resource, and sometimes by their own limited technical experience and fluency. When appropriate Web sites are identified and incorporated into lessons in a meaningful way, the Internet has the capability to have a positive impact on student learning by promoting higher order thinking skills, encouraging active learning, and exposing learners to real world scenarios. When used to its full potential, the Internet is a powerful resource that can enhance secondary mathematics instruction.

Current Status of Internet Use in the Classroom

The National Center for Education Statistics (Kerry & Isakson, 2001) has surveyed public schools annually since 1994 to determine their level of access to the Internet. The U.S. Department of Education monitors public school progress in providing Internet access by sending out a survey each fall to a new sample of approximately 1,000 public schools. The schools selected were representative of a larger population of schools nationwide. By the fall of 2000 it was found that (a) 98% of public schools were connected to the Internet, as compared to 35% in 1994; (b) 77% of classrooms were connected to the Internet, as compared to 64% in 1999, and 3% in 1994; (c) the ratio of students to computers with Internet access had decreased from 6 to 1 in 1999, as compared to 5 to 1 in 2000; (d) the ratio of students to instructional computers with Internet access improved from 9 to 1 in 1999, to 7 to 1 in 2000; and (e) 54% of public schools with access to the Internet reported that computers were available to students outside of regular school hours.

Since teachers play a primary role in the success of technology implementation, an important question to ask is whether teachers are equipped to use the Internet in the classroom. According to Moe and Blodgett (as cited in National Institute for Education Statistics [NIES], 2001):

1. Almost two-thirds of all teachers feel they are not at all prepared or only somewhat prepared to use technology in the classroom.
2. Almost two-thirds of teachers had never used a computer before being introduced to one in the classroom. These teachers need basic technology training, especially those who are receiving computers and using the Internet in their classrooms for the first time. (p. 39)

Most teachers believe they have some basic computer knowledge. In a recent survey, by the National Education Association (as cited in NIES, 2001), 94%
of members were able to surf the web. However, most educators do not know how to apply their web-surfing knowledge in planning technology-based activities. As a result, professional development is the key to effective classroom Internet use. A look at the computer training teachers did receive showed it was usually too generic to help them implement technology into their classrooms: 96% of teachers reported they only received instruction on basic computer skills. In another national survey, Market Retrieval Data (as cited in NIES, 2001) reported that although 78% of teachers received some technology training in the 1998-1999 school year, this training was basic and lasted only 1 to 5 hours for 39% of the teachers and 6 to 10 hours for 19% of the teachers.

Teachers’ Use of the Internet for Classroom Instruction

One research study (Small, Sutton, Eisenberg, Miwa, & Urfels, 1998) used an electronic questionnaire to poll K-12 educators about their use of the Internet for instructional purposes. The categories of educational resources used ranged from broad curricula to single activities. Results indicated that lesson plans were the most sought after instructional resource on the Internet. The data also revealed that most educators utilized several resources (i.e., print, electronic, human) and then adapted what they found to their specific instructional needs. Many teachers reported finding too much information online. As an example, through the Internet service provider Yahoo, a search can generate as many as 30,000 lesson plans. Frequent complaints from teachers when confronted by this “information overload” suggest that it’s time consuming, discouraging, and may in turn cause a premature end to an online search.

Now that most schools are connected to the Internet and more and more classrooms are gaining access, efforts need to be directed toward helping teachers make appropriate use of the Internet in mathematics classrooms. To take full advantage of the power of the Internet, we must use it in “non-transpositional” ways (Slavit & Yeidel, 1999). That is, using it for such tasks as simulating data, electronic process writing, parallel problem solving, virtual gatherings, and dynamic display of information (Barker & Hall, 1998).

Development of Internet Lessons

Internet lessons have the potential to improve learning by engaging students in experiences not previously accessible on a large scale. The rapidly increasing access to and use of the Internet in the classroom has created a corresponding need for the development of Internet activities that exploit the potential of technology as a tool for teaching and learning. The challenge is to extend learning opportunities beyond what is possible with traditional instructional materials.

For the mathematics classroom in particular, lesson plans that incorporate the Internet should integrate the principles promoted in the Principles and Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM], 2000). First, Web-based lesson plans should place high expectations on all students. Lessons should focus on important mathematics that promotes learning for conceptual understanding. Effective teaching will require pedagogical strategies that use the Internet and other technology appropriately and assess students using a plethora of methods.

When appropriate tasks are selected, the use of the Internet in mathematics courses can support meaningful learning. Its use can clarify key mathematical concepts
by using multiple representations of data – symbolic, graphical, and numerical. The Internet can provide experiences that are not readily available in the regular classroom, thereby engaging the learner, providing authentic tasks, and serving as an unlimited source of information from the real world. Computer-based, interactive multimedia materials that offer learner control and real-time feedback can facilitate active learning of mathematics. The Web learner becomes actively involved in the environment, integrating new experiences, making decisions, selecting strategies, and developing models of what was experienced online.

Irving and George (2000) recommended that an Internet lesson should include the following phases: exploration, analysis, construction, and evaluation. In 1997, Slavit and Yeidel (1999) designed Internet activities to be used in a precalculus course that took advantage of the interactive, dynamic capabilities of the World Wide Web. Their framework follows:

1. Students need to construct understanding of the topic in question.
2. Connections between classroom practice and ideas in Web-based activities are fundamental to the activities’ potential impact on students.
3. Students should be required to conjecture, explore, report, and justify. The Web affords an interactive potential that can support these learning behaviors.
4. Web-based activities should be visually appealing, technologically transparent, interactive, contextually based, enjoyable, connected to course content, and conceptual in nature.

Sample Lesson Plans

To illustrate best practices of Internet use, descriptions of six exemplary Web sites with lessons are presented. They represent only a small portion of the excellent sites that are an exceptional resource for the mathematics classroom. In the first lesson students create their own Math Hall of Fame. They are divided into teams of six and each assigned a specific role. Each team is expected to select and justify the choice of six mathematicians who must be representative of mathematicians throughout history. Students can locate biographical information at recommended sites or find their own sites. The activity culminates in a class presentation of their gallery of mathematicians. Lesson plans, suggestions, and much more are provided for the class at the site www.classroom.com/edsoasis.

The Noon Day Project is a historical geometry problem presented using modern-day interactive geometry software available online at http://k12science.ati.stevens-tech.edu/noonday/noon.html. The project describes how Eratosthenes in ancient times measured shadows and used principles of geometry to determine the circumference of the earth. A variety of methods are used in the lesson including computer graphics, interactive applets, paper folding, and videos.

Some of the best practices using the Internet in the mathematics classroom exploit the graphical power of the Internet and require active involvement of the learner. An award-winning site www.seresc.k12.nh.us/www/alvirne.html designed for AP Calculus students and teachers, offers a wide variety of options that can serve any student in or out of class. In addition to guest mathematicians and a problem of the week, students have access to retired test questions and calculator tips. One especially nice feature found at this site
is the student-interactive applets that illustrate some of the most fundamental concepts in calculus.

Two other explorations, available at www.exploremath.com, provide real-time demonstrations of how the functions change through unique multimedia features by allowing the student to adjust constants for each function. One selection focuses on the unit circle and allows the learner to explore the relationship between the unit circle and the trigonometric functions. In a lesson on inequalities suitable for algebra, students can manipulate and visualize the solution sets of linear inequalities through a unique slide bar and shading option.

The fifth site at http://asterix.ednet.lsu.edu/~edtech/webquest/titanic.html brings students face-to-face with the tragic sinking of the Titanic. Through an expansive collection of links, a large database, and suggested resources, students use their statistical knowledge to determine the answer to intriguing questions. For instance, one question asks students to query passenger statistics and to determine if the directive “women and children first” was followed. The site is extensive and provides several lesson suggestions that incorporate video, database queries, and spreadsheet software. Students are encouraged to justify and present their findings to their class.

**Evaluation of Classroom Internet Lessons**

The Internet contains an abundance of worthwhile information, but there are no consistent and established standards for the quality of material (Caruso, 1998). Anyone can post anything they want, whenever they want. Therefore, educators need to approach information found on the Internet cautiously, always assessing its validity and reliability. Evaluation criteria for websites should include exemplary authority, accuracy, currency, navigation and design, applicability and content, scope, audience level, quality, and awards. Associated with each of these criteria is a list of questions that serve to guide website evaluation.

As more and more classrooms are being equipped with Internet access, what can be done to also increase the number of teachers actually using the Internet? The government report (NIES, 2001) on technology in education stated, “Teachers need more than a quick course in basic computer operations. They need guidance in using the best tools in the best ways to support the best kinds of instruction. And they need something more. They need time” (p. 41).

**Teacher Development**

Staff development is essential and can benefit two specific types of mathematics educators. A look first at the preservice teachers revealed it was easier to introduce these new educators to Internet use because they felt more prepared when compared to teachers with 20 or more years of experience (NIES, 2001). However, Pelton and Pelton (1998) stated that these novice mathematics teachers had experienced minimal exposure to appropriately modeled computer instruction, which then limited their implementation of technology in the classroom. These same researchers found that staff development in technology and Internet use not only improved preservice mathematics teachers perceived self-efficacy, but also influenced their decisions of when and how to incorporate computer use in their classroom.

Pelton and Pelton (1989) pointed out that many universities now require courses focused on educational computer technology. Many of these programs incorporate technology into their new teacher certification plans. As an example, Brigham Young University initiated a course that addressed the needs of the
preservice teacher. In this study, the goal was to encourage teacher use of the Internet as an instructional tool with the rationale that:

1. It facilitates distribution of information without the use of paper.
2. It gives the students access to the extensive education resources on the Internet.
3. It encourages communication between students through e-mail and participation in the course newsgroup.
4. It provides a model of actually teaching with technology.
5. It helps students to become familiar with the potential of the Internet in education. (p. 82)

As a direct result of this course, students reported an increase in technical knowledge and in their confidence in using the Internet in the classroom. However, there was no evidence from any longitudinal studies to suggest that there was increased classroom use of the Internet or if Internet use was sustained over an extended period.

The second type of mathematics educator, the veteran teacher, felt less prepared than the novice teacher, and this in turn, limited integration of technology and use of the Internet into the classroom. What can seasoned teachers do to increase their use of the Internet? Most courses offered for teachers only addressed basic computer skills such as word processing. These courses did not provide the needed instruction on how to develop necessary instructional strategies that integrate the Internet into the mathematics curriculum. However, some courses available online did address this need. In one such site, www.massnetworks.org, geared for an introduction to the Internet for teachers, the author presented topics such as technical computer jargon, communication, browsing, Internet searching, and classroom integration of the Internet. Although a helpful site, because it was primarily text, it did not expose the user to the interactive capabilities available online.

In contrast, one such course available at the site http://tft.merit.edu offered this dynamic approach to Internet teacher development. Designed with the intent to help teachers who wanted to learn more about integrating the Internet into their current teaching practices, this course allowed teachers to work alone or with other teachers and a facilitator. Modules in the course covered such topics as finding educational materials, selecting Internet activities, and describing new ways of learning online. Another course specifically designed for mathematics teachers used the Internet to increase teachers’ knowledge of the NCTM Standards (1991). Through the use of a hypermedia version of these professional standards, users could select from menu items that were then linked to a Web page providing an introduction on using authentic classroom activities and materials.

In conclusion, the Internet can provide mathematics educators with a variety of instructional strategies that can enhance classroom experiences. Finding and incorporating these online resources into the mathematics curriculum is one of the many challenges teachers confront when implementing these activities into their classroom. NIES (2001) recognized the importance of teacher development and called it the critical element necessary for the effective use of technology in the classroom. Through the use of timely and innovative teacher development that is focused on teacher’s instructional use of technology and the Internet, teachers can become empowered to transform their mathematics classroom into a classroom of the future.

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