ENHANCING MATHEMATICS LEARNING THROUGH WEB BASED ACTIVITIES

KOUFOPOULOS EMM. IOANNIS

University of Athens, Greece E-mail : ikfpls@yahoo.gr, ik@edumedia.gr, Phone number : 6999 213 213

Abstract

In considering those forms of teaching and learning that most favour the use of information and communication technologies, this article addresses assumptions related to web based instruction; describes educational uses of Web and learning activities and portrays the potential impact in mathematics learning outcomes.

Keywords: *Web based instruction, web based activities, mathematics*

DEFINITIONS

Internet: Is the worldwide telecommunications system that provides connectivity for millions of other, smaller networks; therefore, the internet is often referred to as a network of networks. It is also a collection of the many different systems and protocols.

World Wide Web or www: The most wide spread protocol of internet.

Web Based Instruction (WBI): A general term that denotes several other terms such as Web Teaching, Web Assisted or Supported Instruction, Web Based Learning, On-line Teaching, e-learning, etc.

Any form of instructional delivery in which the www is included as a tool, (Relan & Gillani 1997).

An environment created on the www in which students and educators can perform learning related tasks. It means you can use the Web as a repository students can access to retrieve any information that would be useful to them. Not only can you use the Web to help distribute information - you can also place the information in a form that goes beyond text and takes advantage of the media that will help students understand better and to which they can relate more easily. (p.1 & p.139,McCormack & Jones, 1998).

Learning: "Learning" does not mean how well students perform on standardized tests. That's not learning, as researchers and educational reformers are coming to understand it. There's a dynamic shift occurring as we move from traditional definitions of learning and course design to models of engaged learning that involve more student interaction, more connections among schools, more collaboration among teachers and students, more involvement of teachers as facilitators, and more emphasis on technology as a cognitive tool for learning.

Blended or Hybrid Learning: Refers to a combination of learning methods (including, but not limited to, online and face-to-face instruction). The advantage of blended learning is that it uses the best features of each delivery method—for example, the immediate feedback that happens in classroom learning and the self-paced exploration that's possible in online learning. (Technology & Education, An Encyclopedia)

Learning objects: Learning objects are small chunks of learning or individual digital resources that provide a new way of thinking about learning content and delivery. Attempts to define this elusive concept have created controversy and vivid metaphors, ranging from LEGO building blocks to atoms to snacking. Learning objects promise to make the design and development of instructional material streamlined and cost-effective.

They promise to make customized learning experiences available to every student. Once created and catalogued, learning objects are placed in a learning management system (LMS), and it is here that students engage with the material. (Technology & Education, An Encyclopaedia)

Virtual manipulatives: A *virtual manipulative* is "an interactive, Web-based visual representation of a dynamic object that presents opportunities for constructing mathematical knowledge" (Moyer, Bolyard, & Spikell, 2002).

INSTRUCTIONAL USE OF WEB

There are a number of reasons why a teacher might choose to use Web-Based Instruction, including:

- enhancing student learning
- spending more time with students working in small groups or one-on-one
- reducing repetitive teaching tasks
- reducing paper flow and management, and
- providing improved instructional materials. (Mathew & Dohery, 2000)

According to Ells (1998) the Web offers educational possibilities including: simplified creation, distribution and maintenance of educational materials; student-centered learning; multiple channels for educational participation; content reinforcement; easy access to current information; and multimedia presentation of content. Owston (1997) provides an explicit reason of using web: "One of the primary advantages of web use is that it appeals very much to the way our students now prefer to learn. They play, are entertained by, and learn with the computer. They tend to be more visual learners than previous generations because their world is reach in visual stimuli. They also thrive on interacting with the device. So it is fitting that we design learning materials and opportunities that capitalize on what we know about how our students prefer to learn."

Kurubacak, G., made a collection of opportunities that WBI provides to students:

- are responsible for their learning process and results
- have the freedom to move from their environment to anywhere all over the world
- have a choice of content, time, resources, feedback, and a variety of media for expressing their understanding
- can explore existing resources and information according to their needs and interests
- can construct their own knowledge by engaging students' thinking skills
- can learn through exploring the foundations, justifications, decisions and value of a fact, principle, skill, or concept knowledge
- have a choice whether actively participate in learning activities or just observe them in the background
- meet their own specific needs in self-paced and self assessing environment.

DIFFICULTIES IN LEARNING MATHEMATICAL CONCEPTS…

According to numerous educational research results the transition from concrete examples to the abstract concept, the process of abstraction, is the most demanding step in learning mathematics. Serious difficulties were found in understanding and using definitions of mathematical concepts; most students build their own mental model for the concept, so called concept image, by collecting more or less vague attributes and properties of the concept, and tend to use these instead of the concept definition itself. This happens often even though they may know and are able to express the exact definition (Pesonen Martti).

Research in cognitive psychology indicates that our brains store knowledge using both words and *images. Instruction that targets and engages both of these systems of representation has been shown to significantly increase students. comprehension and retention. Nonlinguistic representations also provide strong support for more advanced mathematical concepts in algebra, geometry, statistics and calculus. (Cholmsky, P., 2003)*

Hence the teaching of mathematics should focus on providing more meaning to students encouraging them to think logically, develop their number sense and cultivate a true mathematical understanding (Dekkers, A.)

...AND THE SHIFTING ROLE OF WEB-BASED ACTIVITIES

With computers it is possible to construct activities that combine the doing and the understanding, possibly equipped with automatized control of success. Another advantage is that working around a computer drives students in lively discussions, and having to do and think makes them much better engaged in the work than ordinary exercise sessions (but there are also counterexamples: some students don't like struggling with computers, and some get easily frustrated if they are not able to solve the problems immediately!).

Sedighian [1997] states that the difficulty in helping students learn mathematics is twofold: one is to motivate them to want to spend time and engage in mathematical activities, the other is to aid them cognitively to construct mathematical knowledge.

Technology used in the mathematics classroom can take many forms, whether it be calculator, spreadsheet, dynamic geometry software, statistical software, computer algebra systems, data collection probes, or interactive websites. These technology tools can enhance and extend the learning of mathematics for all students from kindergarten through college. In Principles and Standards of School Mathematics the National Council of Teachers of Mathematics (NCTM) identified the "Technology Principle" as one of six necessary principles for high-quality mathematics education. This principle states: "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM 2000, 24).

Web-based tools and activities can be an effective adjunct to the mathematics curriculum. Many are designed to provide visual representations of math concepts. Analyzing these representations supports understanding of more abstract, symbolic concepts; the ability to translate from one form of representation to another is an important factor in problem-solving. When the representations are dynamic and interactive they can aid students in seeing underlying patterns and recognizing critical elements, which also is important for grasping math concepts. (National Center on Accessing the General Curriculum, the report was developed by CAST, 2003)

Looking for conclusions about the effectiveness of web based activities on mathematics learning in elementary school particularly, we gave preferences to those data of early-stage implementation of the online curriculum content developed to date by The Le@rning Federation, involved schools in both Australia and New Zealand.

Several key messages emerge from this study:

- Students highly appreciate the opportunity to learn Mathematics with these digital resources. Not only do they find the materials engaging, but more importantly, they recognise the learning design principles embedded in them (interactivity, cognitive supports, ability to repeat activities, immediate feedback, ability to work at their own pace) as helpful to their learning. Nevertheless, they want the learning objects they use aligned to their age and cognitive abilities.
- Most teachers too recognise online curriculum content as helpful for teaching and learning Mathematics. However, (and as is the case with most curriculum innovation), for effective integration of these new online curriculum materials into pedagogical practice, classroom teachers, and school and system support personnel, need time together to: Explore, understand and reflect on the affordances the new online curriculum materials have for teaching and learning. Select and align learning objects to system curriculum requirements and to the appropriate cognitive abilities and skills of their students. Plan, prepare and evaluate learning activities which take advantage of and support the teaching and learning opportunities offered by the online content.
- The online curriculum content should improve students':
- Motivation; Persistence; Depth of learning; Higher-order concepts; Collaboration with peers; Independence in learning.
- Students will be asked whether or not the online curriculum content is:
- Interesting and fun; Easy to work with; Helpful in thinking about new ideas; Best when student worked with a partner; Such that the student needed a lot of help from his or her teacher.
- Students are also asked about the helpfulness of various characteristics of the learning objects, including:
- Sound; Animation; Interactivity; Self-paced; Repetition until successful;
- Reception of feedback; Clear instructions for improvement.

EPILOGUE

Every teachers' ambition is to create a classroom where students eagerly and massively participate, help one another, where deep understanding of mathematical concepts occurs, verified by multiple assessments, and where multiple modes of learning are designed into learning. And as Martin Ryder in "The World Wide Web And the Dialectics of Consciousness" writes: "For the first time since mythical Theuth invented the written word, we have a medium which has no centre podium and offers no privileged position for any message; a medium which allows teacher and learner to share a common space in which there is no established authority, but uses widely distributed knowledge resources to forge new levels of

consciousness; a medium which fosters creation of learning communities supporting active collaboration among anonymous peers, freely sharing artefacts that emerge out of this activity. These are the possibilities that distinguish the Web from all other mass media." As Web based instruction is an innovation and as such, needs a process of careful evaluation and monitoring in its needs analysis, design, development and implementation. Teachers are obliged to evaluate and monitor their plans, decisions and actions to make sure that they are consistent with the realisation of their primary goals of improving teaching and learning outcomes. Thus, feedback is central to the process of innovation as it is to the process of learning (Marshall, 2000).

BIBLIOGRAPHY

Cholmsky, P., *WHY GIZMOS WORK: Empirical Evidence for the Instructional Effectiveness Of ExploreLearning.s Interactive Content*, ExploreLearning December 2003

Dekkers, A., *The Development of Web-Based Learning Resources for Mathematics*, online: www.sci.usq.edu.au/staff/ spunde/delta99/Papers/ dekkers.pdf

Ells, R. (1998). *Effective use for the Web for Education: Design principles and Pedagogy.*

Freebody, P., *Early-stage use of The Le@rning Federation's learning objects in schools, Results of a field review* (January 2006)

Kurubacak, G., *Online learning: A study of students' attitudes towards* WBI, Dissertation, University of Cincinnati, (2000)

Marshall, s. (2000). Developing IT based opportunities and resources: A work in progress. Report presented at *Educating for an Information Age* Seminar, Macquarie University, Sydney.

Mathew, N., Dohery-Poirier, M. (March 2000). *Using the World Wide Web to Enhance Classroom Instruction*, First Monday, volume 5, number 3

Moyer, P. S., Bolyard, J. J., & Spikell, Mark A. (2002). What are virtual manipulatives? *Teaching Children Mathematics*, 8(6), 372-377.

Owston, R.D. (1997). *The World Wide Web: A technology to enhance teaching and learning?* Educational Researcher, 26(2), 27-33.

Pesonen, M. E., *Experiments on using interactive web-based mathematics problem sets based on dynamic geometry applets*. Online: www.joensuu.fi/mathematics/MathDistEdu/Sortavala2003/ ArticlePesonen6thConferenceFinal.pdf

Relan, A & Gillani, B. B. (1997). Web Based Instruction and the tradional classroom: *Similarities and Differencies*. In Khan, B. H. (1997) Web Based Instruction. (pp. 41-46)

Sedighian, K. (1997). Challenge-driven learning: A model for children's multimedia mathematics learning environments. *Proceedings of ED-MEDIA 97: World Conference on Educational Multimedia and Hypermedia*. Online: http://taz.cs.ubc.ca/egems/reports.html

Books

Khan, B. H. (Ed.). (2001) Web-based Training. Educational Technology Publications, USA.

Kovalchick Ann, Dawson Kara (Ed.), *Education and Technology. An Encyclopedia*, , ABC CLIO, Santa Barbara, Ca. USA

McCormick and Jones D.,(1998). *Building a Web-Based Education System*. New York: Wiley.

Pallof Rena, Pratt Keith, *THE VIRTUAL STUDENT, A Profile and Guide to Working with Online Learners*, Jossey-Bass, (2003)

Shank Patti & Sitze Amy, *Making Sense of Online Learning A Guide for Beginners and the Truly Skeptical*, Pfeiffer (2004)