Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση

Τόμ. 1 (2008)

6ο Συνέδριο ΕΤΠΕ «Οι ΤΠΕ στην Εκπαίδευση»

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Βιβλιογραφική αναφορά:

Doering, A., Miller, C., Scharber, C., & Veletsianos, G. (2026). Iterative Design of Geographic Online Learning Environments . *Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση*, *1*, 260–263. ανακτήθηκε από https://eproceedings.epublishing.ekt.gr/index.php/cetpe/article/view/9569

Iterative Design of Geographic Online Learning Environments

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ABSTRACT

This paper presents an overview of three online geography education environments designed to help learners solve authentic and complex problems, and enable instructors to teach with such problems. In addition, we use design-based research to discuss how the evolution of the original two online learning environments provided a foundation for the development of the third environment, and examine the influential roles that teachers and learners played in the design of such online environments.

KEYWORDS: *Design-based research, Online learning, Iterative design, Geographic learning*

INTRODUCTION

How should a K-12 geography teacher use a geospatial technology such as Google Earth in the classroom? Should he or she have students pinpoint a series of locations and measure the connecting distances, essentially using the technology as a mere digital representation of the traditional globe? Or, should the teacher encourage learners to harness the powerful data-driven affordances of the technology to make and justify decisions on contemporary issues. We believe that using geospatial technologies to solve contemporary, relevant, and authentic problems represents the best use of the technology. However, there is a necessary level of technological, pedagogical, and content knowledge that an instructor must develop in order to apply this scenario successfully in the classroom.

In this paper we 1) present an overview of three online geography education environments (i.e. MSE, LGGT, and Geothentic) designed to help learners and instructors engage with authentic learning, 2) use a lens of design-based research to discuss how the evolution of the MSE and LGGT environments provided a foundation for the contemporary development of Geothentic, and 3) examine the influential roles that teachers and learners play in the design of such online environments.

GEOGRAPHY LEARNING ONLINE

Geographic education curricula have frequently used geospatial technologies (GT) such as geographic information systems (GIS) to assist learners in meeting the National Geography standards. A GIS is a geospatial technology that allows a user to store, retrieve, manipulate and display geographic data about any place in

the world. Although it has been noted that GIS is the one technology that can assist students in meeting *all* of the National Geography Standards (Audet & Paris, 1995; Bednarz, 1999), the actual implementation of GIS within classrooms is far behind expected rates (Kerski, 1999). Authors (2007) argue that the integration of this technology within curricula has been greatly hindered by the lack of teachers' technological and pedagogical knowledge.

The United States and the European Union are currently highlighting the need for geographic literacy (Congressional Record References, 2005; Donert 2003). These developments have fast-forwarded the need for educators to effectively teach the geography using geospatial technologies (Baker & Bednarz, 2003). Bednarz and Audet (1999) and Authors 2 have identified numerous reasons that current approaches to teaching GIS in K-12 classrooms have not been effective which include: (a) the inadequate training of teachers to use GIS, (b) a lack of pedagogical teaching models, and (c) the failure of preservice teacher education programs to teach GIS in ways that are applicable to the K-12 classroom. These problems are also cited by Sanders, Kajs, and Crawford (2001) and continue to hinder the successful use of GIS in education.

We launched the Multi-Scaffolding Environment (MSE) in response to the lack of pedagogical models. MSE created opportunities for students to learn content with geospatial technologies by solving authentic and complex problems in an online environment. The online environment was designed with a focus on using four scaffolds to assist learners through a learning experience: a situated movie, a screen-capture video, a conversational agent, and a collaboration zone (Authors 3). The heart of MSE was the scaffolds that provided on-demand assistance as learners solved geographic problems such as identifying the best location to build a trout habitat restoration project. Although MSE was used with much success (Authors 4), the project was still in its infancy.

Using the designs of MSE, Learning Geography through Geospatial Technologies (LGGT) evolved with a focus on assisting teachers in developing their technological pedagogical content knowledge (TPCK). Although the aesthetics of the design were inferior to MSE, the content was superior with a teacher environment (TE) and a student environment (SE) that worked together to assist both the teachers and the students. Each of these environments provided specific assistance to the intended audience. Within the SE, learners had access to scaffolds at any time as they solved authentic geographic problems using various layers of data. Within the TE, teachers are given assistance on how to teach geography using GT by having access to scaffolds focused on knowledge development based on the theoretical concept of technological pedagogical content knowledge (Mishra & Koehler, 2006; Hughes, 2000) within the domain of geography.

Based on the design, development, and research of MSE and LGGT, Geothentic was born. Geothentic, funded by the National Geographic Society, is the latest iteration of designing a geographic online learning environment to support teachers and students to effectively use geospatial technologies to learn geography. Currently in the first year of development, Geothentic is employing years of

research and input from teachers and users from MSE and LGGT to design a technologically, pedagogically and aesthetically sound learning environment.

DESIGN-BASED RESEARCH

Currently, we are using a lens of design-based research (DBR) to examine how the theoretical foundation of the Geothentic project has been enhanced through an iterative continuation of design, implementation, and research. DBR focuses on broad, complex instructional problems that are best examined through the exploration of natural context and stimuli, as opposed to controlled, artificial factors (Design-Based Research Collective, 2003; Lavie & Tractinsky, 2004; Reeves, Herrington, & Oliver, 2004). Often achieved through collaboration among practitioners, researchers, and users over an extended, long-term engagement (Reeves et al., 2004), DBR clarifies relationships between practice, theory, and design (Design-Based Research Collective, 2003). In recent years, DBR has become an especially appealing empirical methodology for instructional designers interested in producing change and enhancing the learner experience through development of technologies that support learning in actual classroom environments (Sandoval, 2004).

The present technological and theoretical foundations of the Geothentic online learning environment stem from a three-year, iterative evolution of pedagogical objectives, contemporary design approaches, and research-based classroom implementation. Through these iterative cycles the primary focus of the project has shifted from providing a selection of learning scaffolds to support learners (MSE) to also assisting teachers develop their technological, pedagogical, and content knowledge (TPCK), to transforming the ways each scaffold is utilized (Geothentic). In other words, design implementations shifted from individual, component-like tools for the learner, to instructor support tools, to designs focused on the interplay of synced-scaffolds.

ITERATIVE DESIGN BASED ON TEACHER-STUDENT INPUT

Teacher insights and input were heavily considered and incorporated in the design and development processes of these geographic online learning environments as they progressed from MSE to Geothentic. In the summer of 2006, the environment designers received input from twenty-two pre-service teachers about MSE. In addition, during spring 2007, eight in-service teachers gave input into LGGT during a meeting where they utilized the environment and given professional development. After the teachers' recommendations were incorporated in the design of the environment, these teachers then utilized LGGT in their classrooms for an entire semester, providing further input into design and development as they used it.

Building on the work of MSE and LGGT, the third generation of this geographic online learning environment, Geothentic, was established and funded by the National Geographic Society in 2007. This grant has built into its design and development two iterative cycles of pre- and in-service teachers' input. For exam-

ple, in the first cycle select K-12 geography instructors were invited to a workshop to learn how to use the Geothentic environment and to provide formative and summative feedback on the screen capture and situated videos, conversational agent, and chat-visualization tools. The DBR examination of Geothentic and its predecessors will provide valuable findings that can be used to communicate how, when, and why certain design principles work in practice. This information will be essential, and extendable, to the instructional design field as we aspire to achieve elevated levels of learner engagement through design, implementation, and research of innovative and contemporary online learning environments.

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