Evolving the Infrastructure for Technology-Enhanced Distance Learning

Vincent P. Wade
Trinity College Dublin

Helen Ashman
Nottingham University

The growth in available broadband network services and mobile access, together with the sophistication of emergent learning environments and adaptive multimedia technology, is greatly enhancing the distance learning experience. The combination of innovative pedagogic strategies and dynamic, ubiquitous access is encouraging novel (distributed) learning technologies. However, the challenges of providing active, stimulating, and authentic learning experiences that support learner collaboration, construction, and reflection remains key to successful distance learning technologies.

A key aspect of most of the innovation in technology-enhanced learning has been the move toward more learner-centric solutions in which student inquiry, activity, and engagement are key requirements that e-learning application developers must satisfy. This more learner-centric approach has greatly influenced several key trends in technology-enhanced learning:

- a move toward more constructivist approaches to learning environments, in which the learner is active in collecting, analyzing, composing, and evaluating knowledge, information, and artifacts.
- the embedding of collaboration, social interaction, and community within learning opportunities and experiences;
- an evolution in personalization of the learning experience and process so that it can dynamically recognize and support diverse learner needs and requirements; and
- the emergence of games, mobile systems, and ubiquitous technology to provide more immersive and augmented experiences.

These areas of research present very significant challenges for Internet-based

e-learning researchers and developers. The next sections briefly outline these areas and identify some current research initiatives addressing them.

Active Learner Construction and Collaboration

Technology-enhanced learning, or e-learning, doesn't actually have separate theoretical models for learning but rather, as Terry Mayes and Sara de Freitas indicate, provides "e-enhancements of models of learning. That is to say, using technology to achieve better learning outcomes, or a more effective assessment of these outcomes, or a more cost-efficient way of bringing the learning environment to the learners."[1] Increasingly, mainstream approaches to learning have emphasized constructivist assumptions — that is, that we gain understanding through an active process of creating hypotheses, and build new forms of understanding through activity. Related to this idea is that of contextual influence on learners. More specifically, learners are affected by the cultural and social setting in which they learn. By incorporating community and social interaction (learning by networking and collaboration) into the learning environment, we can enhance learner motivation, activity, and self-esteem. Thus, learning technology has increasingly sought to support learner activity and learner-centric environments, as well as learner collaboration in the construction of information and knowledge resources. We can see examples of distance learning technology's evolving aspects in the evolution of learning-management services and platform functionality (such as Sakai, the Learning Activity Management System (LAMS), and WebCT/Blackboard) as well as in the increased integration of the collaboration and social networking services of Web 2.0 (blogs, wikis, community environments, and so on).

A key challenge in this endeavor is to support the integration and interoperability of e-learning tools and applications over the Internet. For this reason, IEEE and several industry bodies have developed standards to support exchange of content, models, application, and performance information. Based on the IEEE Learning Technology Service Architecture (LTSA), these standards aren't intended to prescribe learning activities and tools, but rather define a service-oriented architecture for systems interoperability, multimedia content exchange, and learner knowledge sharing.

Evolution in Personalization

A second key trend is driven by the recognition that learning environments must support learners' diversity and individual needs. This diversity can include learner differences in prior knowledge, competencies, learning style, communication preferences, cognitive style, and so on. Based on sound pedagogic strategies, personalized e-learning would ideally offer multimedia content, activities, and collaboration adapted to learners' specific needs and influenced by their specific preferences and context. Personalized e-learning can enhance users' learning experience in terms of relevancy, motivation, effectiveness, efficiency, and satisfaction. The challenge in successfully developing personalized e-learning services lies in the complexity of both developing adaptive e-learning systems and authoring such adaptive e-learning experiences. Research in personalized learning technologies has so far focused on fusing intelligent systems and (semantic) Web technologies. Examples of personalized e-learning environments include the Adaptive Hypermedia Architecture (AHA!),[2] Knowledge Tree,[3] and the Adaptive Personalized e-Learning Service (APeLs),[4] which have achieved dynamic personalized composition of multimedia content based on a learner's prior knowledge, interests, and demonstrated achievements. You can find further information about personalized adaptive e-learning systems via the Prolearn Network of Excellence (www.prolearn-project.org).

Games and Ubiquitous Technology

Games have a long tradition in learning, with both formal education and corporate (professional) training using myriad computer-based learning games. Key elements of learning games include providing users with meaningful (personal or collective) challenges, opportunities to explore new experiences or information, and a means of achieving self-improvement (so-called "wins") or increasing self-esteem.

One key benefit from a learning provider's perspective is the enhanced personal motivation that good games can engender in the learner. This adds to the enjoyment and longevity of the learning experience and also helps students to progress in the learning activity.

Emergent technology in graphics as well as mobile and ubiquitous technology is moving learning games to a new level of immersion or augmented reality. In such games, learners not

only receive meaningful challenges and exploration opportunities but also have opportunities to socialize (via multiplayer networked virtual worlds) or play using a combination of virtual worlds and physical environments (augmented reality). This combination of (typically mobile) network access, virtual reality, and ubiquitous devices can provide a powerful basis for next-generation learning games (http://iperg.sics.se/).

In this Issue

The challenge for any developer of distance learning environments or Internet applications is how to balance the learning theories' educational imperatives while selectively developing and integrating appropriate technology, tools, and services to enhance the learning experience. The articles in this special issue examine key areas of evolution in learning technology and standards while attempting to maintain the balance between educational imperatives and technology offers.

In "The Pragmatics of Current e-Learning Standards" Vladan Devedžić, Jelena Jovanović, and Dragan Gašević outline some key learning technology standards related to learning resources and systems interoperability, and focus on the pragmatic role these standards play on learning system development. The article provides insights into the different standards and their impact on interoperability and reusability, and poses challenges for the continued development of these standards, with particular reference to the Semantic Web.

Declan Dagger and his colleagues explore the evolution of learning-management systems, from large, single-system platforms to more agile, service-oriented frameworks, in their article, "Service Oriented E-Learning Platforms: From Monolithic Systems to Flexible Services." More specifically, the article identifies the different aspects to the "interoperability challenge" that e-learning developers must address to realize the service-oriented architecture vision of next-generation learning systems. The authors examine service interoperability, context (semantic) interoperability, and personaliza-

tion as key capabilities that must become part of mainstream e-learning service environments.

Finally, in "Visualizing Online Interaction to Increase Participation in Distance Learning," Jeffrey Saltz and his colleagues focus on a specific e-learning service — called iPET — that combines social networking and visualization to enable tutors and students to improve their understanding of participation in online discourse and thus improve their overall learning experience. The article explores how visualization and the social network affect students' motivation and participation, without increasing the overall student or tutor workload.

This research is only a small part of the evolving field of technology-enhanced distance learning. However, different combinations of service-oriented architectures, Web 2.0 technologies, personalization, and ubiquitous technology, appropriately aligned with educational imperatives and theories, will significantly shape distance learning experiences over the next decade.

References

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Vincent P. Wade is the director of the Intelligent Systems Laboratory at Trinity College Dublin. His research focuses on the development of processes and technologies to support adaptive Web systems, with a particular interest in personalized e-learning. Wade has a PhD from Trinity College Dublin. Contact him at vincent.wade@cs.tcd.ie.

Helen Ashman is the director of the Web Technologies Research Lab at the University of Nottimgham, UK. She has a PhD in computer science from the Royal Melbourne Institute of Technology (RMIT) in Australia. Contact her at hla@cs.nott.ac.uk.

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