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# <u>AA</u>n Examination of the Impact of Emerging Technologies on eLearning

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## Abstract

eLearning has, to date, mostly been a matter of content being displayed on PCs running Windows, Linux, or MAC OS. Emerging technologies have recently, however, expanded the capabilities and scope of portable and mobile devices to such a degree that it is possible to use them as eLearning media much more effectively than it was even a year ago. Devices such as PDAs with high resolution screens, phones with higher bandwidth for image and video exchange, iPod and other portable video players, and built-in WiFi and Bluetooth connectivity have significantly altered the eLearning system designer's job and responsibilities. New interface ideas, taking into account the need for engaging and multi-modal access to eLearning content, have added to the possibilities for eLearning systems.

This paper describes the approaches we are taking in the eLearning project at our institute to address the impact these technologies have and will have in the future. Specifically, the paper will examine work we are undertaking on new interface paradigms and on emerging devices such as the Sony Reader and Nokia 770 WIFI enabled web tablet.

## *Introduction*

The impact of newly emerging technologies on the eLearning market and user communities is only now beginning to be understood. These technologies include advances in hardware such as PDAs connected to WIFI networks, mobile telephones with web surfing capabilities, new display technologies, and new devices appearing almost weekly. The technological advances also include software and systems ranging from social networks, declarative interface languages, Web 2.0 and Ajax, to semantic Web

In an effort to further an understanding of how these new technologies will affect learning modes, content creation, and educational philosophies, our lab has embarked on a set of research projects to develop applications of new technologies to the eLearning space.

## *Hardware*

Hardware devices contribute significantly to the look and feel of eLearning content. The movement from PC's and laptops to devices with smaller screens is accelerating. The majority of people in the world will not interact with the internet through a PC. Rather, they will use mobile telephones, PDAs and other small screen devices.[2]

## Small Screen Devices

New hardware devices such as the Nokia 770[3] or the iPod provide interesting alternatives for the deployment of eLearning content. The 770's screen resolution is 800 x 480 but is less than 141 x 79 mm. The device is, in most respects, a standard web browsing platform. However, its small size and portability make it an interesting device for eLearning. In particular, because the screen is so small, even though the resolution is high, the visibility of graphics and interpretability of complex graphical screens is limited.

eLearning systems deployed to such screen sizes must take into effect the small size and adjust accordingly. For example, busy graphics with a great deal of content may need to be simplified with labelling increased in font size.

## Passive Interaction Devices

Devices such as the iPod (and other MP3 players) are emerging as an intriguing platform for distributing eLearning content. However, they fall into a class we designate as *passive interaction* devices. These are devices which do not allow for interaction from the student that can be captured, measured, or used to change the flow of the material. That is, these devices are players of content only and any *interaction* is in the student's mind and level of understanding.

In addition to iPods, DVD players, ebooks, audio lectures, and in some variations, televisions are passive interaction devices. These are all devices which do not, by their nature, allow for interaction from the user which can be easily captured and measured, yet they are common devices for eLearning deployment. This creates some difficulties for eLearning content developers.

Consequently, with the exception of new devices such as the iPod, eLearning systems are moving away from passive interaction devices. The final resolution of the question of iPod's contribution to eLearning is yet to be determined. This difficulty with interaction, and consequently with assessment, may make the attractiveness of the iPod for eLearning content deployment may be short lived.

## *Active Interaction Devices*

By contrast, devices such as PCs, PDAs, mobile phones, and the like are active interaction devices. These devices allow for the collection of usage data, entry from the student, and in more current devices, input from sensors attached to the device. These sensors range from simple date and time clocks to complex GPS data collectors. Active interaction devices, however, are specifically classified by their ability to solicit or demand interaction from the student during the presentation of eLearning content.

## Mobile Devices

Mobile phones make possible a great deal of *Just In Time* learning by which students can grasp exactly the information needed for a specific task at a specific time. However, the small screen and the very limited or cumbersome interface of the telephone keyboard make

interaction difficult. eLearning content designed for these devices will have to take these limitations into account.

In addition, mobile phone users are notoriously impatient. This means that users searching for content expect that content to appear quickly and as the first response to a query. Consequently, an eLearning system to be deployed via mobile phones (the most common platform for accessing services) must employ a highly accurate and fast search engine. More about this will be discussed below in the *Software* section.

## Software

Software technologies are evolving as rapidly as hardware in the area of eLearning, New technologies for content management and delivery are emerging. In particular, at the institute, we are investigating the application of semantic web technologies to the challenges of eLearning[4].

Semantic web technologies such as ontologies and the use of RDF for knowledge representation and relationship management make possible new forms of eLearning content and delivery. Social networks of classmates and colleagues can be defined and exploited to provide more effective experiences for the student. Many of the traditional problems with eLearning such as abandonment of courses, boring content, and assessment difficulties can be better addressed with semantic technologies. Exploiting new semantic connections and social relations the delivered content becomes more engaging to the student.

In addition, semantics added to course content can allow systems to adapt the content to the context in which it is being delivered. This provides eLearning vendors the ability to create content which automatically adapts to the context of the student's viewing device, location, or situation. This is particularly useful when content needs to be used both for structured learning as well as single module, just in time learning.

## Digital Libraries

Digital libraries and, in more advanced systems, semantic digital libraries such as JeromeDL[5], are software controlled repositories for eLearning content. Traditional digital libraries may be coupled with a simple keyword search engine that allows for the contents to be search and retrieved quickly if appropriate keywords are known. Semantic digital libraries are appearing now which utilize semantic technologies and ontological search algorithms to provide high speed search based on concepts and inter-relationships, not just keywords. Semantic digital libraries aim to improve user experience in search and browsing[6] based on the semantic annotations within the context of social networks of students and teachers; these search and browsing technologies range from query expansion[7] and query answering[8] to faceted navigation to social semantic collaborative filtering[9]. Semantic digital libraries are not only digital content management services, but have grown to be a part of the evolving space of semantically-enabled services, actively used by large, online communities of users. Highly and meaningfully interlinked content allows teachers to easily build new, appropriate courses; students are more encouraged to browse the knowledge space beyond the information delivered in the course. These technologies are

particularly applicable to eLearning as they encourage both blended[10] and discovery learning techniques[11].


## Human Computer Interface

Human interface technology is evolving as well. A trend is emerging among researchers to use game-like metaphors and paradigms for information systems. These interfaces allow the users to explore a learning space or landscape. During that exploration, learning to use the system is implicit and thereby engagement with the user is maintained. eLearning systems can use such interfaces to improve the experience of the student, make the content more relevant and useful.

Adding semantic technologies to the interface framework, a current project at our institute, provides the ability for eLearning systems to couple with adaptive interfaces that leverage knowledge of the student's context. Such interfaces change their look to accommodate different interface devices, both those that support active interaction as well as passive interaction. The intent of such interfaces is to preserve the *feel* of the interface experience, the ambience and game like nature of the interface even when the *look* must change to accommodate the device capabilities and specifics.

The user's context, semantically annotated, allows machines to understand more about the user's behavior, needs and expectations; it positions the student not only in the physical space and time, but also within the network of social interactions. The first one (physical space) can allow to e.g. overlay appropriate learning material on the view from a the camera embedded in the mobile phone; while the latter one can adapt the look and feel  to the current role, e.g., a student, the user play in his social network.


## *Conclusion*

Emerging technologies will have significant impacts on eLearning content, styles, and delivery systems. New hardware devices will offer a new set of possibilities for both structured and informal learning, but will need software systems designed to leverage new software technologies most efficiently. In particular, these systems will need to adapt both content and interfaces to the context of the user.

[1] *Digital Enterprise Research Institute, National University of Ireland, Galway (NUIG)*
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[3] *http://www.nokia.ie/web/product_details?productId=232&kwc=KNC-FV6467507742&CMP=KNC-google&HBX_PK=nokia-770&HBX_OU=50*

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[10] *http://www.learningcircuits.org/2002/aug2002/valiathan.html*

[11] *http://coe.sdsu.edu/eet/Articles/discoverylearn/index.htm*