RESEARCHING EMERGING TECHNOLOGIES AND ENVIRONMENTS IN SUPPORT OF NEW LEARNING SCENARIOS

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Abstract: New generations of learners require more engaging and interactive learning solutions to satisfy a wide range of styles, preferences and needs. Emerging technologies can be empowered for contemporary learning environments building, making it possible to achieve rich learning experiences. In this paper we provide an overview of several key development trends in learning environments building. We analyse novel technologies like mobile technologies and augmented reality supporting different learning contexts. The aim of this review is to facilitate educators in their choice of learning environment development, providing learners the needed on-demand information and knowledge.

Key words: environment, mobile technologies, augmented reality, QR code, learning

1. INTRODUCTION

In a world of rapid change it is vital that learning adapts to meet challenges as they are presented. A wide range of technologies is currently available to support new and diverse learning approaches, extending and enhancing traditional provision in a variety of ways. New and emerging technologies are invariably within the scope of educators and researchers, because of their possibilities to connect three major dimensions of learning resources: learning collaborators, learning content, and learning services (Chang and Sheu, 2002; Sung, 2009). An emerging trend is related to the rapid development of mobile technologies. They propose increasing learners’ capability to transport their own learning environment in time and location.
Performance of learning activities on mobile devices working local or remote with content, access to services and interactions among learners and educators through written messages, images, video and voice is associated with gaining of given learning experiences (Chang, 2007). This experience could be rich and engaging only if the appropriate scenarios for given context are created. Other directions of technologies development indicated from recent research include Augmented Reality (AR) technology. The term “augmented reality” has emerged to describe a system of applications and devices that allows a user to view virtual 3D objects in the real-world environment (Wikipedia, 2011). The virtual objects may be stationary or manipulated, seen on a mobile device display, on a large flat screen or in a heads-up display. To realise the greatest efficiency and cost effectiveness in their utilization for learning, technologies need to be explored and learning strategies to be proposed.

In this paper an overview is provided of several key development trends in the building of learning environments. Mobile and AR technologies supporting different learning contexts are analysed. The review will be of use for educators who select the most suitable learning environments to provide learners with on-demand information and knowledge. It aims to summarise perspectives and experiences among lecturers to respond to the increased expectation of integrating these technologies in Higher education or other similar environments.

2. SPECIFICATION OF MOBILE LEARNING ENVIRONMENTS

The rapid development of mobile technologies prompts many researchers to question to what extent they can enhance learning experiences (Chen and Kinshuk, 2005; Duncan-Howell and Lee, 2007). Mobile learning (mLearning) has been seen as an approach to electronic learning (eLearning) that uses mobile devices and provides a qualitatively different learning experience.

Mobile learning environments basically consist of portable communication devices and specific mLearning applications that give the learner access to learning content and knowledge. The main characteristics of such environments as effective learning providers are reliant on correct definitions of learning objectives and learning activities, the achievement of desired learning experiences, the choice of appropriate components of the mobile environment, and analysis of the learning context (Figure 1).

A clear definition of learning objectives benefit learners to understand learning activities and what is expected from them at the end of the course (McKimm and Swanwick, 2009). Generally, achieving objectives is a big part of what motivates them, and these objectives could be adapted to match the situations and expertise of individual learners. Objectives are measured by outcomes and feedback.
The appropriate planning of learning activities using mobile devices reflects on achievement of effective learning experience, receiving new or improving existing skills. Further, enabling some form or social interaction can encourage group experiences or the facilitation of relevant collaborative learning throughout, or at strategic points in the learning process. This can support the learner in developing appropriate social and team skills and may assist team building or collective action in reaching joint learning objectives. In combination, these factors can engage the learner, facilitating self-motivation and self-regulation.

When learning activities on mobile applications are engaging, motivating, satisfying and enjoyable, positive outcomes are achieved. Moreover, carefully organised content should enhance the learning experience by enabling the learner to make better sense of the material.

The important features of a Mobile learning environment are evident:

**Mobility**: This enables learners to enjoy continuous access to content and services and connections with their peers/tutors whilst they are outside the reach of conventional communication spaces.

**Communication realization**: Learners/educators that use mobile technologies can be in perpetual contact. This sense of communication support tends to contribute to the other possibilities of mLearning in use, for example personal learning, collaborative learning, etc.

**Management of profiles and roles**: In terms of the different roles and profiles in the learning experience, there is a need to manage these relationships in a way that
acknowledges the role of stakeholders and honours the integrity of all involved parties.

**Suitable user interface:** Constraints of mobile devices include small screens, restrictive input methods and limited battery life. Therefore, the interface design for m-learning services should meet users’ needs without imposing unnecessary complexity, slow operation or excessive power consumption upon them.

**Access to rich media objects:** Successful mobile applications provide access to many rich media objects. One of the commonly stated characteristics of mLearning content is that it should be delivered in small chunks rather than large units of information, which can be supported by appropriate use of different media types. In turn, these media types should support content appropriately.

Mobile learning can be used in a range of learning contexts: as a part of a blended learning programme and in very different ways to traditional learning. In the first situation it can be used as a pre and/or post activity, emulating the classroom experience (Pieri and Diamantini, 2009). In the second example it can be applied for achieving interactions within a physical environment (The Ambient Wood Project, 2002).

### 3. CHARACTERISTICS OF AUGMENTED REALITY ENVIRONMENT

AR technology has now matured to the point where it can be applied to a much wider range of application domains: military, economics, natural sciences, etc. (Wieczorek et al., 2010; Saenz, 2010). The research shows that this technology also adds great importance in the area of education, for a number of reasons (Kaufmann and Meyer, 2008; Winter and Pemberton, 2008).

AR technology has the capability to engage and motivate learners, which are pivotal concepts in most major theories of learning, and that is well documented in the literature both for school and museum contexts (Billinghurst, 2002; White, 2003). The suitability for collaboration and natural communication supports learning through social interaction and knowledge construction, and specifically in a museum context, satisfies the demand for group learning experiences. It is possible to offer different views of the same object or situation, to address various aspects in learning theory and facilitates extrapolation, knowledge transfer and cognitive development through adaptation.

The 3D presentation of objects and scenes addresses the spatial abilities of learners as an important component of human intelligence and lends itself to the exploration of special problems difficult to convey in books.

AR technology helps to put objects and situations into context by offering related information, and provides a bridge from instruction to construction by transforming static objects into interactive content. The potential for new facets of
expression offers a largely unexplored playground for exploration and experimentation.

The potential of AR to promote better learning is seen in the development of a new kind of printed books, where three-dimensional virtual models are integrated on the pages via a given code. The models appear attached to the real page, so users can see the AR scene from any perspective simply by re-orienting themselves or the moving the book. Users can change the virtual models simply by turning the book pages. When they see a scene they particularly like, they can fly into the page and experience the story as an immersive virtual environment (Fermoso, 2008).

As has been described, AR environments expose learners to an experiential, explorative, and authentic model of learning early in their higher education careers as well as when they enter into life as workers, educators, researchers. AR supports active learning modes and thus become more successful learners.

![Fig. 2. Specification of Augmented Reality learning](image)

4. A SCENARIO FOR EMERGING TECHNOLOGIES UTILIZATION

Mobile technologies can support learning only if students are equipped with the requisite mobile devices and suitable software applications. To investigate the students’ readiness to use mobile technologies a survey tool was created. The responses of students in their bachelor degree second year in Technical University-Sofia, College of Energetics and Electronics are summarized in Table 1. The results show that 66% of male students and 55% of female students have internet access on their mobile phones. 55% of male and female students use cell phone for texting; 66% from male students and 88% of female students for pictures taking; 77% of male and female student for music listening; 66% of male students and 77% of female students for video recording, 55% of male and female students for web browsing, 44% male and 33% female for accessing Facebook. Students were next asked to
suggest how mobile technologies could facilitate their learning. Many suggested that they had experience working of concrete tasks in their everyday life, but at that moment they do not possess clear answer. Notwithstanding, 77% of male students and 88% of female students were interested in receiving class updates as text messages.

| Table 1. |
|---|---|
| Is your phone internet data enabled? | Do you use your cell phone for texting? |
| ![Graph](image1) | ![Graph](image2) |
| Do you use your cell phone for taking pictures? | Do you use your cell phone for playing music? |
| ![Graph](image3) | ![Graph](image4) |
| Do you use your cell phone for recording videos? | Do you use your cell phone for web browsing? |
| ![Graph](image5) | ![Graph](image6) |
| Do you use your cell phone for accessing Facebook? | Do you interested in receiving class updates as text messages? |
| ![Graph](image7) | ![Graph](image8) |

The responses from students indicate that all had mobile devices and they used them in one or more ways, although they had not considered how mobile and
communication technologies could be helpful in their study. We should thus offer them clear opportunities to support their cognitive, knowledge gathering and learning processes through utilization of mobile and AR technologies. A first experiment was to provide them with QR codes and AR markers for use during their courses in Computer Graphics and Internet Technologies.

Utilization of QR codes is one method to gain access to stored information and services through mobile devices. AR markers give additional meaning in 2D or 3D format to visualise a real scene or event. The literature exploration shows that these technologies provide learners with speedy and ready access to multimedia learning resources, information and services in one interactive and enjoyable way. In education, QR codes and AR markers are preferred in a number of scenarios: personal learning, group interaction, critical thinking, collaboration and discovery, assessment issues. The three main components required for the realization of learning with emerging technologies are devices and software for access, good learning scenarios and different formats of learning materials. These are depicted in Figure 3.

![Fig 3.Provision for emerging technologies utilization](image)

One scenario for project-based learning that integrates mobile and AR technologies as applied to Computer graphics course is presented on Figure 4. The project-based learning includes the following steps: (1) Introducing students to the state of the art problems and demonstrating the huge potential of working topics; (2) Identification of challenging problems and solving the problems by students; (3)
Setting up the driving questions about what has to be accomplished and what content has to be studied; (4) Introducing students to the environment for problem solving (including collecting and managing its main components when students organize their PLEs) with 3 main components: digital resources (marker AR gallery, tutorials, best practices, papers), web-based applications/tools and free hosted services; (5) The process of the actual investigation is performed: how tasks that require higher-level and critical thinking skills can be completed, including analysis, synthesis and evaluation of information; (6) Guidance is provided when students need it (through student-educator interactions, peer counseling, guidance, project templates, etc.); (7) Assessment of the students’ knowledge and competences as a result of the project work.

Fig 4. A scenario of project-based learning

4. CONCLUSION

The world is changing fast, and current forms of knowledge often become quickly outmoded. Today’s learners need new skills to be able to find knowledge that is relevant, up to date and dynamic. They require learning experiences that are responsive to their needs, and they often require them within a mobile context. mLearning with its various forms and contexts must be considered as serious alternatives to traditional forms of learning and for it to be successful, compelling and engaging scenarios need to be applied. Most students are equipped with mobile devices but their effective use and adaptation in formalised learning contexts is dependent upon the appropriate design of pedagogic formats. There is a need for future research in the areas of technology enhanced learning, human-computer interaction and media design with a particular focus on individual requirements and adapted content.
REFERENCES


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