EMPOWERMENT OF TEACHING AND LEARNING CHEMISTRY THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES

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ABSTRACT

There is an obvious growing of the importance of information and communication technologies (ICTs) in science education. It is used as a tool for designing new learning environments, integrating virtual models and creating learning communities (e-learning). However, e-learning used in teaching and learning chemistry, including informative material in electronic forms such as; www-pages e-mails, and discussion forums enhances teaching and learning chemistry. In addition to the material delivery and implementation of new electronic tools the e-learning process requires support in technical matters, especial activation of learning processes, and cooperation between teachers to exchange their experiences and ideas. It is very important to create e-learning in high quality that requires quality management to standardize approaches of e-learning. International cooperation would emphasize these requirements, and even more. In this paper I report experiences of developing a bilingual (English-Arabic) chemistry course in which web or virtual learning environment has been utilized. There is a need for increasing cooperation between teachers, in different countries web-based teaching and learning chemistry. Nowadays extremely actual and perspective educational technique is used, which is the mobile learning (m-learning). Mobile learning is the intersection of mobile computing (the application of small, portable, and wireless computing and communication devices) and e-learning (learning facilitated and supported through the use of information and communications technology). Mobile learning that provides learning is truly independent of time and place and facilitated by portable computers capable of providing rich interactivity, total connectivity, and powerful processing. In May 2005, Ellen Wagner, senior director of Global Education Solutions at Macromedia, proclaimed that the mobile revolution had finally arrived. *[AJCE 4(3), Special Issue, May 2014]*

INTRODUCTION

Information and communication technologies (ICTs) have become one of the fundamental building blocks of the modern societies. Many countries now regard the mastering of the basic skills and concepts of ICT as an inevitable part of the core of education. To this end, various new models of education into the teaching and learning environment, such as e-learning, m-learning, and other Web- based technologies. The effective integration of such applications however, depends to a large extent on teacher's familiarity and ability with the IT learning environment. However, 21st century declared to be the age of information and communication technology. We cannot work in the society without on-line technology. Online technology is also entered in the field of education. This article is about the integration of ICT as a tool with the overall aim of empowering teaching and learning chemistry.

WHY EMPOWER TEACHING AND LEARNING CHEMISTRY

Chemistry is considered as the central backbone for all the other scientific disciplines. It is a creative science essential for sustainability and improvements of our way of life. The aim is to outline the objectives and related activities of the ICT, such as e-learning and m-learning that empowers its education. Chemistry teachers need to know exactly how ICT is used as a teaching and learning tool, for their own purposes and to help students understanding.

One of the ICT opportunities in teaching and learning chemistry is to help students to visualize the spatial three-dimensional (3D) elemental and molecular structures, and allows collaborative interactions between teachers and students, and among students themselves, synchronously and asynchronously. ICT is considered as a veritable source of scientific data, theoretical information and offers a viable means to support authentic learning in chemistry. The

scope of information that are available over the Web and in other ICT- based cognitive tools, also virtual labs and simulations should be a part of teaching and learning chemistry at all levels, in order to enrich the understandings of its concepts and theories in different contexts.

WHAT IS THE ELECTRONIC LEARNING?

Electronic Learning is a subset of Distance Learning and Mobile Learning is a subset of E-learning. E-learning and m-learning have become extremely important buzz words of the education technology revolution each characterizing a whole raft of ideas and resources for teacher. But the two terms are not always used correctly; there is some confusion between them. However, differentiation between them can be particularly useful for teachers who use technology in the classroom, as it can help them to pick out which techniques are best for their education scenario. The present paper highlights the comparison of concept, characteristics, advantages, disadvantages, similarities and differences between E-learning and M-learning [1].

COMPARISON BETWEEN E-LEARNING AND M-LEARNING

E-Learning

E-learning refers to electronically supported learning and teaching using any form of digital communication, electronic devices or the internet. The learning process might be described as a form of e-learning, which also comprises education technology. E-Learning includes such processes as computer based learning and internet based learning, but it is important to remember that it does not necessarily require either a computer or an internet connection but only the use of electronics, such as a CD Rom, watching an educational television program, or computer conferencing.

It also includes delivering content via the Internet, intranet/extranet (LAN/WAN), audio and videotape, satellite broadcast, interactive TV, and CD-ROM. However, the advent of the internet is the real catalyst for many important advances in e-learning that allows internet-based educational activities such as collaborative online learning or interactive educational resources. It is a structured purposeful use of electronic system or computer in support of the learning process [2] to covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration [3].

Benefits of E-Learning

E-learning is a fantastic resource for making chemistry lessons more interesting and interactive, using online learning platforms like Game Classroom or Quizinator to transform traditional classroom learning. It is also particularly effective for flipping the classroom. The 'flipped classroom' is a new model where teachers allow students to use their homework time to study new topics and learn the basic information they need to know, which they usually would have imparted to them in class. Class time is then used to go through activities and exercises to reinforce and test their understanding of the new concepts – an activity that usually forms the basis of homework. E-learning is fantastically effective on both sides of the flipped classroom, with great online resources like Chem Collective, allowing students unprecedented learning experiences in their own homes, whilst brilliant programs like Fifty Sneakers make testing and evaluation fun and exciting back in the classroom.

M- Learning

M-learning is an abbreviation of mobile learning, which means learning using mobile portable devices that allow the student to learn in different environments and while he is moving instead of being restricted to a place or tied to a PC or a laptop. Mobile learning is, of course, by its electronic nature, a subset of e-learning, but it refers far more specifically to these handheld devices and portable technology. The term has grown enormously in popularity in the past few years, with the advent of handheld wireless devices such as iPods, tablets and increasingly sophisticated mobile phones such as iPhones and android handsets expanding the potential applications of the concept exponentially.

However, there are many definitions for M-learning such as; the use of mobile or wireless devices for the purpose of learning while on the move, or any sort of learning that takes advantages of learning opportunities offered by mobile technologies, i.e. acquisition of any knowledge and skill through using mobile technology anytime, anywhere that result in alteration of behavior. M-Learning brings strong portability by replacing books and notes with small RAM's filled with tailored learning contents.

Benefits of M-learning

M-Learning is best used in scenarios where concrete benefits are gained from the potential for mobility. For example on class field trips, students who use mobile devices are keeping engaged and working whilst still giving the freedom to explore. It is also extremely effective to use m-learning in classroom environments where modern technology may not be available to all students, or in schools where there are not sufficient resources for all students to be able to use a device. In such a situation, using mobile learning device like a single tablet,

which may be passed easily from hand-to-hand or shared amongst a group of students, is a great way to ensure that pupils are still able to benefit from the diverse opportunities presented by education technology.

An app like Mind Snacks, which presents language learning in simple, digestible chunks with fun, easy-to-use games, is a great example of m-learning solution that can be simply and quickly passed between students as they reach new levels to enable successful team-based learning. Mobile learning or M-learning is the idea that a student can learn from any place at any time using portable learning devices. This means that learning is accomplished with the use of small, portable computing devices, such as cellular phones, smart phones, palmtops, personal digital assistants (PDAs) and handheld computers; tablet PCs, laptops, and personal media players can also fall within this scope [4]. However, there is some debate on the inclusion of tablet and laptop computers.

Similarities between E-Learning and M-Learning

- Each of them needs an infrastructure and a wide community base in dealing with wire and wireless electronic computer technologies.

- Each of them needs a high cast technological system.

- Each of them provides students with digital literacy focusing on information processing.

- Students are centre of learning process in both models (Self- Learning).

- In both learning models students can access and surf the internet.

- Each of them allows communication between individual students and between students and teachers anywhere at any time locally and internationally.

- In each of them the learning content is delivered electronically, in the form of texts, images and video clips.

- Both learning models depend on developing problem solving and creative thinking skills among students.

- Both are capable of providing learning opportunities to many students.

- In both models learning material can be updated continuously in both learning models

Differences between E-Learning and M-Learning

- E- Learning uses fixed, wire devices such as PC's, but mobile learning uses wireless communication devices such as cell and smart phones, micro computers and personal digital assistants.

- In E- learning, access to the internet is achieved by the available telephone service, while mobile learning uses IR when accessing the internet anywhere at any time.

- In E- learning, messages are exchanged via the internet whereas in M-learning, MMS and SMS messages are used to exchange information between users.

- In E-learning, it is difficult to transfer books and files between individual learners, while in mobile learning, Bluetooth and IR technologies are used to exchange books and files among learners.

- Storage applications used in E-learning are more effective than ones used in mobile learning.

- Communication channels used in E-learning have low protection levels as learners use more than one device, whereas mobile learning provides users with more protection as learners use their own devices to connect with others.

- It is difficult to pass devices through learners in E-learning while these devices are easy to pass between learners in mobile learning.

Advantages of E-Learning

- Individualized instructions: E-learning provides individualized instructions suiting to the need, abilities, learning styles and interests of the learners. E-learning has much potential to make the education, instruction and learning opportunities provided to the learners adaptable to the need, local need and resources at their hands. Therefore, it is learner centered.

- Easy access: The learner gets access to learning by breaking all barriers of time, place and distance. The learners can access information and educational contents anytime and at anyplace. E-learning is available even in areas where there is no school or college. It can reach any remote or far off areas of the country or world.

- Qualitative: E-learning has a unique feature for allowing access to unlimited number of students the same quality of the content that a fulltime student has

- Effective media: E-learning can prove an effective media and tool for facing the problem so lack of trained teachers, shortage of schools and needed facilities for providing quality education to the number of students residing in far and wide corners of the country.

- Different learning styles: Unlike traditional classroom education, E-learning can cater to different learning styles and promote collaboration among students from different localities, cultures, regions, states and countries.

- Flexibility: The flexibility of E-learning in terms of delivery media (like CD, DVD, Laptops and Mobile Phones), type of courses and access may prove very beneficial for the learners.

- Play-way spirit and learning by doing: Learning experiences via simulated and gaming techniques may also provide the advantages of getting richer experiences on the useful pedagogical footings of play-way spirit and learning by doing or leaving.

- Interesting and motivating: E-learning may make the students more interested and motivated towards learning as they may get a wide variety of learning experiences by having an access to multimedia.

- On-line, Off-line and live interaction: The opportunities of having an on-line, off-line and live interaction between the students and teachers and among the students themselves may make the task of E-learning a joy and best alternative to the lively face-to-face interaction and real time sharing of the experiences in a traditional classroom settings

- Self-learning and self-improvement: E-learning leads to self-learning. It can be utilized for improving technical and vocational skills.

- Evaluation and feedback: E-learning can also provide opportunities for testing and evaluating the learning outcomes of the learners through teachers, peers and auto-instructional devices and software available with there a ding material online, or through the internet and mobile phone facilities

Advantages of Mobile learning

- Increased mobility: Learning is not restricted to fixed locations any more.

- Mobile educational systems allow lifelong learning through distance learning.

- The learning material is mostly colorful encouraging students to go back and forth and practice more.

- Learner gets stimulated in learning, convenient, and interesting.

- Time-saving: People can now study when they are commuting and traveling.

- Environmental-friendly: It is amazing to find out how much information a mobile device can carry despite its light weight. Less printing is required.

- Interactive: Mobile technology enables students to closely link with their peers, teachers, distant partners, and even interest groups worldwide.

- Use of relatively inexpensive everyday technologies.

- Better opportunities to acquire skills at one's own pace, with a degree of privacy that may be missing when using shared computer facilities or relying on equipment belonging to somebody else.

- Good support for preferred modes of interaction, e.g. accessing audio content or participating in social networks on the move.

- Catering for interests beyond what is provided in class, through access to additional content such as podcasts or free learning materials (e.g. Open Learn).

- Handheld devices are often an everyday part of business, so learning can contribute directly to enhancing employability, life skills and work practices.

- Opportunities for learners to give immediate feedback on their learning experience.

- Learning materials can become accessible to a larger audience, through podcasts, mobile applications, blogs and e-books, which are seen by potential students.

- Revitalizing the curriculum, rethinking teaching methods and implementing improved feedback to learners.

- Turning geographically dispersed learners into a valuable teaching resource by enabling them to contribute their local knowledge and research data more easily.

- Making the learning experience more tailored to the changing needs of individuals, encouraging learners to return for knowledge updating and further study.

Pedagogical Implications of Mobile Learning

Mobile computing/communication devices offer a unique opportunity for teachers and students in different kinds of instructional settings to capitalize on the flexibility and freedom afforded by these devices. If appropriately facilitated, mobile learning can benefit learners by providing them the instructional materials and interaction through their mobile devices wherever and whenever they need it. Instructors also benefit where they can access services and interact with students while on the move. To keep up with this changing phenomenon and to effectively facilitate mobile learning, argued it is imperative that instructors learn about and adapt to the changing environments, when and where appropriate. We predict that mobile technologies will help in teaching and learning chemistry, especially in the rural areas, disables, etc.

The mobile educational revolution can be borderless through the cell phones, MP3 players, portable game devices, tablets, and laptops, especially students and teachers are increasingly connected and digitally communicating with each other in ways that would enhance teaching and learning chemistry, in the middle East.

However, we argue that mobile/electronic education should not replace traditional education with tutors and instructors, but support both student and teacher by providing services that facilitate teaching, learning and education-related administrative tasks. The basic approach is

integrative, combining a variety of devices (mobile and non-mobile) via a variety of transmitting techniques (wired and wireless).

TEN EASY STEPS KEY TO A SUCCESSFUL E- AND M-LEARNING

There are ten easy steps to help designers to construct pedagogically sound e-learning chemistry courses and related activities which are:

1. Well defined needs for the e-learning.

2. Well established infrastructure such as networking, Servers, e-classrooms accessed with PCs and Internet, communications, intranets, etc.

3. Development of e-learning according to the International standards

4. E-content matches to the curriculum

5. Well articulated e-content according to SCORM standards, that effectively designed to meet online delivery e- and M-learning goals and objectives, and students needs.

6. Well trained teachers and students.

7. Evaluation of using e- and M-learning

8. Sustainability of the system

9. Well established platform in which content is delivered (Internet, Intranet, LAN, Videoconference, satellite, Cloud, etc.)

10. Well established e-content developing and delivery centers including; development facilities, professional technical team, consultants, trainers, ongoing technical support, etc.

CASE STUDIES

A bilingual (English-Arabic) Chemistry course has been developed by Awad and Stovall [5] through the UNITWIN between UNESCO and University of Illinois (Urbana-Champaign) using WebCT software as a learning management system (LMS). It is deployed for e-learning in the Faculty of Women for Arts, Science, and Education, Ain Shams University. As a part of the e-learning process its impact on teaching and learning chemistry has been evaluated. Also M-learning has been deployed for teaching chemistry [6]. Moreover, 55 courses in other disciplines have been developed and delivered using Moodle as a LMS [6].

Impact of Teaching and Learning Chemistry Using E-Learning and Mobile-Learning

Study of the impact of using ICT on teaching and learning chemistry showed that it:

- Increases student's attraction and interest to learn chemistry

- Helps students to understand chemical education

- Supports students with the required memorization.

- Increases student participation in classroom activities with the increase of their understanding and skills, both in chemistry and IT.

- Enhances teaching of chemistry due to presence of the guided inquiry, 3D molecular structures, equations, graphics, animations, quizzes, etc.

- Helps in teaching and learning using virtual labs, where it reduce or completely eliminate the use or production of hazardous substances and chemical pollutions (green chemistry).

- Helps in assessment and assignments.

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