

Chapter 4

Development of E-Learning in Higher Education and Future Directions

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Teachers and students in higher education are coming to realize that to become competent practitioners there is a need to take advantage of up-to-date digital technologies and learning practices. The learning process requires measurement and evaluation of students' behaviour. In the case of e-learning, evidence is sought for improvements resulting from the use of online tools and processes designed to achieve a given set of learning outcomes. In this 21st century, knowledge is fast becoming a powerful engine in life. The visions, innovations, and inventions are the building blocks for developing a knowledgeable and sustainable society. E-learning has facilitated the use of a plethora of internet and web-based applications as the method of communication with a distributed audience. Therefore, institutions of higher learning are constantly venturing into new and innovative methods and are radically changing the educational practice, making it competitive. This paper examines how emerging technologies and e-learning are being used in education to create a major shift in the educational service paradigm that promises major advantages over the traditional distance learning and face-to-face systems. The authors present developments in distance education and e-learning whilst clarifying the similarities and differences between them. We identify factors affecting the development of e-learning systems and examine the implementation of some systems

in pervasive distributed computing environments. For everyone everywhere, the present developments in e-learning spells more access for learners, cautionary expansion for universities, and accelerated learning and influences for the future. The future directions is such that the higher educational system of the future and especially in Europe must aim to meet human development needs with e-learning playing some major parts through promotion of access and widening participation in knowledge and skills acquisition. In order to support learning in evolving dynamic environments, several factors must be taken into consideration. These range from policies, strategies, the current education environments and business needs as well as the specific discipline being studied. Since the advent of e-learning and its eventual implementation in higher education, the world of learning for both the advanced nations and emerging economies have witnessed an upsurge in the number and types of students who are now engaged in pursuit of studies at institutions of higher learning. This paper reports on issues relating to expectations of the university of the future and the future of universities.

INTRODUCTION

E-Learning has revolutionized the mode of education delivery in further and higher education institutions. A major part of this involves the use of computer-mediated communication (CMC), which can improve communication over face-to-face mode. With CMC there is less distortion of information and a perceived higher level of satisfaction and comfort for the learner. The quality of the relationship between the tutors and students is affected by the medium of communication and the form of information distributed. For many fields of specialization especially where education is based on accuracy and practice, CMC and the internet have great potential for the students.

There is a paradigm shift in educational services delivery, by taking cognizance of the fact that there are differences between people in how they seek education information which could depend on age, income and background resulting in the preference for online or offline mode of seeing information, leading to a digital divide. Online students for the most part comprise digital natives, who in some cases are younger, have hunger for more education, use the internet for other purposes and spend more time online per week. In most cases, education providers remain a source of information and support for behaviour change. Due to the increasing number of learners accessing websites, the development and provision of information for students have become more complex. Issues of culture, language, diversity, economy and time requirements all have to be taken into account.

The education and training of competent workforce and researchers of the future must take advantage of modern digital technologies and learning practices [1]. E-learning has provided some inroads into some approaches for ensuring engagement; however, the ability to customize curriculum to accommodate the needs of the sectors and society must be taken into account. Modules and learning objects which are downloadable and reusable have to be considered. For quality assurance, establishment of consortia for peer review and guidance provision is important. Such groups could look at effectiveness of online delivered learning and usefulness globally. Issues of storage and dissemination

which will require development of resources (human and capital) are crucial to the deployment of e-learning of the future. There are challenges to which solutions must be sought. Some of these relates to assessment, retention and programme evaluation. In the course of learning, assessment should be used to determine progress. Deeper understanding should be promoted which is measurable and evaluated from students' behavior perspective. This in itself is only evident in the effectiveness, retention and positive transfer of the e-learned knowledge and skills into workplace situation. Obtaining this evidence would require further research which involve obtaining and analysing the elements of the process such as planning, development, the learning outcomes, attitude and knowledge and skills acquisition and transfer.

EMERGING ISSUES

In-house training in industry has always been conducted using the face-to-face (F2F) method. Today there is a shift. The use of network technology has become the trend especially in development and training organisations. This has been dubbed the "e-learning revolution" [2]. The authors would like to draw attention to the important factors affecting the adoption and successful implementation of e-learning initiatives. The reasons for the use of e-learning and an outline of the advantages and disadvantages associated with this method of knowledge and skills acquisition, stems from the many benefits it brings to users in addressing challenges that face teaching and learning today.

With the growing emphasis on internationalisation following the introduction of ICT, we find that learning no longer takes place in one single campus. Universities now enter contracts with various institutions worldwide to enable them to support their growing number of teaching and learning activities. This has resulted in collaboration described as a virtual campus or multi-campus education. This present challenges, as it leads to online networks of individuals and learners which may be independent of the institution, sometimes referred to as learning communities or communities of practice.

The formation of such informal online communities responds to a need for individual learners to manage their own learning over the boundaries of institutions and institutional systems [3]. These challenges the closed structure commonly employed by institutions. Social software, Web 2.0 and Web 3.0 are part of this phenomenon. Social software allows links between users and the ownership and control of these links in relation to who is linked and who is not, and what sort of information is shared and what is not shared. The context for collaboration and services include Facebook, LinkedIn, Flickr, Slideshare services, etc. These social software challenges the boundaries of the closed digital learning environments of institutions.

Education institutions and learners worldwide now have access to resources available on Open Educational Resources (OER), which are teaching, learning and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others. These OER include full courses, course materials, modules, textbooks, streaming videos, tests, software, and other tools, materials or techniques used to support access to knowledge for all. The content may be there but the process for use of these resources is up to the individuals or organisations adopting them to develop and implement.

Supporting Learning in Dynamic Virtual Environments

To date, implementation of e-learning has involved voluntary engagement on the part of the students. Recent studies involving examination of use of internet from students' perspective in relation to their views on online teaching, tutorials, assessment and possible future applications, have reported a significant increase in voluntary use of the internet and email [4]. The study revealed and provided evidence that students value social interaction and the use of internet for learning and developing skills. The future would see the sustained use of virtual learning environments (VLEs) and e-learning to support campus education and for development of new and emerging skills for personal and professional development.

E-Learning and Emerging Technologies

People seek to learn through experience. Research has shown that as much as eighty percent of learning takes place outside the formal education system. The lives of people and of societies are becoming complicated and developments become more and more non-linear and non-continuous. The learning environment of a human being consists of a rich variety of different places, spaces and modes. The beginning of the 21st century has shown that virtual spaces have become important.

Access to education information is no longer for the select few (staff and students of any educational institution). Following the integration of systems with accounts provided has in some cases provided access to those who do not belong to any traditional member groups. The use of social networking tools and sites available with free resources will transform teaching and learning into their e-equivalents, almost together into the future.

ORGANISATION OF LEARNING

Problems stemming from the global financial downturn and the globalisation of universities worldwide continue to affect the way learning is organised in Europe and also throughout most parts of the world. The financial crisis continues to affect higher education. The deficits faced by most governments from 2009 may well have an effect on university budgets for the coming years. Thus, e-learning could be used in the next few years to increase the number of programmes that higher education can offer, while maintaining costs and increasing the amount coming from student enrolments. In this context, it may well be that greater efforts should be made to rethink the ideas and methods for return on investment (ROI). Likewise, the crisis will lead to greater use of free content and technology, and less use of proprietary platforms.

'Globalisation' is a term that is currently being used to describe the progressive expansion of the large universities, via their campus networks, into other parts of Europe and the rest of the world. There are key benefits to this trend: improved cost efficiency, curricular standardisation, spread of best practices, etc. The local campuses can play a part in adapting training to socio-cultural contexts with specific needs. Thus, university-business partnerships will increase as a result of the unstoppable trend of students wanting to organise their own learning and link it to their professional objectives.

Learning Production

There are several initiatives seeking to promote and sustain open education and non-traditional sources of learning, including informal learning. The Open Software

foundation continues to support making available free software. Courseware for use in further and higher education institutions are now being made available. These initiatives have received funding support from various sources such as JISC in the UK, NSF in the USA, etc. Among universities participating in the OER initiatives are the Open University and the Higher Education Academy Information and Computer Science (ICS) Subject Centre. We note that the open movement, and ideas of sharing and re-use of materials are going to spread through the university community. This has been the case already, for example, with the use of Moodle in most of Europe's virtual campuses, and the trend is going to grow through the adoption of other learning tools, and social tools in particular. As Stephen Downes [<http://www.irrodl.org/content/v2.1/downes.html> and <http://ijello.org/volume3/IJKLOv3p029-044Downes.pdf>] points out, unlike in the past, international open-source development communities are now consolidated and mature, which means that it is easier to replace the proprietary applications currently used by universities.

Shifting attention to content creation, this movement represents a change in the way contents will be developed and paid for. Several approaches are being explored. Some of these include content assembly for the simpler programmes and a more homogeneously developed and adapted programmes expressing the views and vision of the teacher. In the case of the former, the course content design has more to do with content assembly than content creation and requires more efficient information architecture and management formulas, standards and metadata models at these institutions. However, for the latter, more thought is given to the process, quality and interactivity for deeper understanding of concepts.

Models of Education

The information technology (IT) literacy and level of competence of both tutors and students affects the type of engagement, form of development of instructional materials and students' engagement. One of the main effects of open content has been the notable increase in the amount of educational resources available, whether for free or at a low cost. As the Horizon Report 2010 [<http://www.nmc.org/pdf/2010-Horizon-Report-Preview.pdf>] notes, this has led to a trend in trainers taking on the role of guide, coach or facilitator in a context of overabundance of teaching materials. Students, in turn, no longer need to act as more or less passive receivers and processors of information; instead, they need to be able to search for, assess, interpret and summarize this information. We find that students are being positioned to develop a culture of active learning and engagement with the processes and instructional materials using these tools.

Assessment of learning, one of the main points of criticism of the open model, is evolving alongside this, as peer review, reader rating, tagging and re-tweeting become increasingly common forms of validation [5]. This leads to the need for basic training in ICT (information and communication technology) skills, especially for faculty and other stakeholders – a need that countries and universities are going to have to respond to in the coming years.

Customizing and Expanding the Users' Web

The rise of Web 2.0, otherwise referred to as the users' web, has only just begun. Many universities have commenced integrating applications, such as blogs, wikis, social tagging, video and photo sharing, etc. They are aware of the fact that their students are

using these Web 2.0 tools and sites to learn informally. In some cases, some universities have even started to test social networks like Facebook as the main educational platform for their courses. An example is the FacebUOC Project, an Open Social Learning experience at the Universitat Oberta de Catalunya (UOC) (<http://pretoria.uoc.es/wpmu/joyoflearning/facebuoc-project/>). Although social learning has been a very popular phenomenon in recent years, its actual and widespread use in higher education is something that one may well finally see being implemented in the near future.

LEARNING TECHNOLOGIES

E-Learning consists of content, technology and services. In terms of learning technologies, we think about learning management, content management, knowledge management, content distribution, competency management, collaboration, assessment, reporting, localization and workflow. In recent times the many issues affecting the development and deployment of these learning technologies include bandwidth, virtual learning environments and virtual worlds, the advent of mobile learning and gesture-based computing. As has been the case in recent years, bandwidth will continue to increase considerably. The educational implications of this are great. For example, it will aid the use of applications such as videoconferencing or synchronous team working. It must be noted that owing to the trend of the majority of students not living at home, especially during the latter years of their study at the universities, for instance in France, UK, and Portugal, whilst in their accommodation away from home, they do resort mostly to the use of their PDA (personal digital assistant), which leads to decreased bandwidth.

Virtual Learning Environments

The transformation of learning management systems into personal learning environments (PLEs) will probably continue to be seen to be the main trend. The possibilities of personalising educational experience have to include proposing a work environment that is designed in terms of each student's interests and needs, and in which they take responsibility for this design. There are many initiatives in this area – some of these include the UOC's campus (whose design is based on the Google Gadgets API) or the University of Aveiro's campus (<http://campus.ua.sapo.pt/>).

Given the fact that many universities are currently forcing their students to use more than one platform or a range of tools so as to be able to offer them different services, the prediction is that in future virtual environments will have to integrate all these different tools, and allow for their use and intercommunication via standards-based interoperability. This will represent a paradigmatic change where we move towards the idea of virtual learning environments as repositories for web-based learning tools. These are tools that can be incorporated into each campus in terms of the desires of users and administrators, and which are able to intercommunicate and offer a global educational experience. We believe the same is going to be the case for social networks like Facebook or Google Wave, which look to offer social functions, email and file sharing within the same tool.

Mobile Learning

The number of mobile phone users worldwide has now reached 4 billion [5]. It was predicted that 2010 would be the year that we would see serious experimentation with augmented reality. The European Smartphone market has grown exponentially, and developers and users of platforms such as Android or iPhone operating systems are increasing the mobile repositories for augmented reality resources. The spread of mobile web access and the possibilities for context-aware applications, and geographical positioning systems (GPS) in general, offer a wide range of opportunities for exploration. Thus, rather than see mobile devices (and Smartphone in particular) as basic tools for virtual courses, they will mainly be used as resources and support for these courses. This is most likely to be true with some limitations in the cases to do with science courses, which will never be delivered satisfactorily through PDAs. One of the reasons being the size of the screen, which is too small. iPad could have more to offer in future.

The market for videogames based on augmented reality will be of particular interest, especially in terms of user and data networks, which may represent a new way of showing relationships and connections in the 'real world' [6]. The cost of producing serious games is a drawback as many people with various skillsets (Corsortia of multimedia developers and computer programmers) are needed for the finished product.

Another type of mobile device, the e-book, has been the protagonist since 2009, thanks to its offering particular comfort in terms of access to information, and portability when reading teaching materials or any other kind of materials [5]. In 2010 and beyond, these devices are expected to offer more services or see increased use of those tools already in existence, especially internet connectivity, collaboration and tools for taking notes and editing contents. It is not quite clear as yet what success innovative devices such as the iPad will have, which incorporate the typical features offered by netbooks, alongside touch screens and a resolution normally found on a desktop computer.

VIRTUAL WORLDS AND GESTURE-BASED COMPUTING

Despite the 'educational disappointment' with immersive environments, and Second Life in particular, a few years ago, new educational uses of tools based on 3D are starting to come to the fore and are under consideration in many university faculties. The challenges facing development in this area arise from the complexities of the objects used and the integration of the various aspects for meaningful use to be made in the context of teaching and learning. This would prove useful as the trend for blended learning develops where there is a drive for seamless transition from one learning activity to another. Such a transition could be one from live group activities to individual exercises or from activities in small groups to activities in a large learning community.

The way in which we relate to computers is changing. Models such as those put forward by Apple with its iPhone, based on finger movements, represent a step forward in the development of interfaces that adapt comfortably to typical human gestures [5]. Videogames already show the possibilities available, for example with the Nintendo Wii, which uses common movements in the 'real world' as an interface for gaming. Likewise, educational tools and simulations, in particular, are going to be able to incorporate these possibilities for interaction. There is the problem of the cost of development. Simulations require the participation of specialists in the field of science. We distinguish between two categories of simulations: the ones which derive from research directly and the others

developed by geeks, that is, scientists with programming skills. The use of collaboration and social networking tools through sharing and exchanges could see progress in this area.

Virtual and Remote Laboratories

On-line laboratories or remote laboratories provide distant access to hands-on experiments and extend to the learners new possibilities of using lab equipment without location and time restrictions. They also help the dissemination of hands-on activity, very relevant in science and technology areas. Nowadays, many universities already have laboratory environments online through using the web. Recently, at the IGIP'09 International Conference, in Austria, September 2009, the Ministry of Education, Arts and Culture presented four such environments to promote education – one of them was entitled “Remote and virtual labs”. This new tool for teaching/learning purposes is no more a discussion but a reality, and they have been used at the Faculty of Engineering at the University of Porto (FEUP), Portugal.

At FEUP, the host institution of one element of this group of authors, a state of readiness has been demonstrated for improving the collaboration between universities and secondary schools by organising learning scenarios [7-10], where students have remote access to real laboratory experiments located in different university laboratories. Also, some virtual 3D replicas of some experiments available in each student computer are offered [11, 12]. The main idea is to organise, in the near future, a working network of real and virtual laboratories to facilitate strategic sharing of pedagogical practices providing distributed remote access to, in some sense, expensive prototypes as test-beds and for establishing long term collaborative schemes between universities and between schools and universities. This is a first step to bridging the gap between science and applications, theory and practice. This will place a strong emphasis on science and pedagogical innovation providing an experimental way for good practices dissemination.

Remote and Virtual Experiments

A remote experiment (which may also be named a remote laboratory task) is a real experiment (or a set of experiments) remotely accessed. The user interacts (unless the experiment is of sensitive type) with the experimental system remotely located, through a user friendly and virtual interface located in an informatics platform – as is the case of a personal computer. Examples of high level of this concept and not available for anyone (although, not using the internet as the communication technology) are the interaction and control of Hubble telescope or the ROV's [13].

In a virtual experiment the user interaction is restricted to a computer environment based in a developed application supported by a system model. Those types of experiments may be accessed remotely or may be uploaded to the user PC. A real experiment is tied to a real set-up. A virtual one has the inherent freedom and the flexibility coming from its virtual characteristic [14]; see Figure 1. If the virtual experiment is well structured and designed it could be of a higher cognitive stage for training purposes. Also, many industries make similar use of the web for supporting their products and services or of virtual systems for training. In terms of university education, the role of experimentation is a key concept, especially in science and technology courses, but even also in medicine! Having the remote experiments ready all the time, the

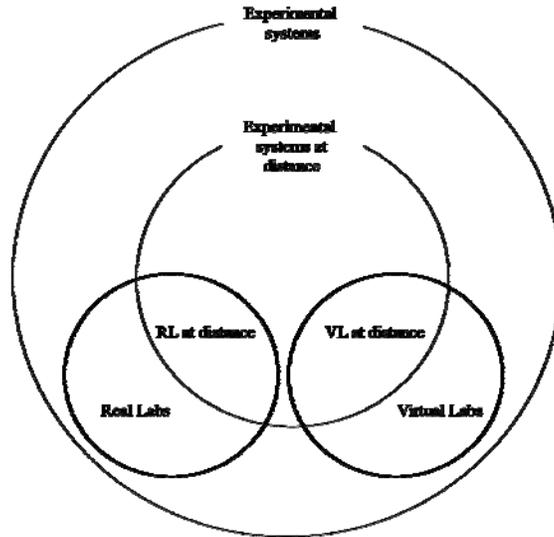


FIGURE 1
EXPERIMENTAL SYSTEMS

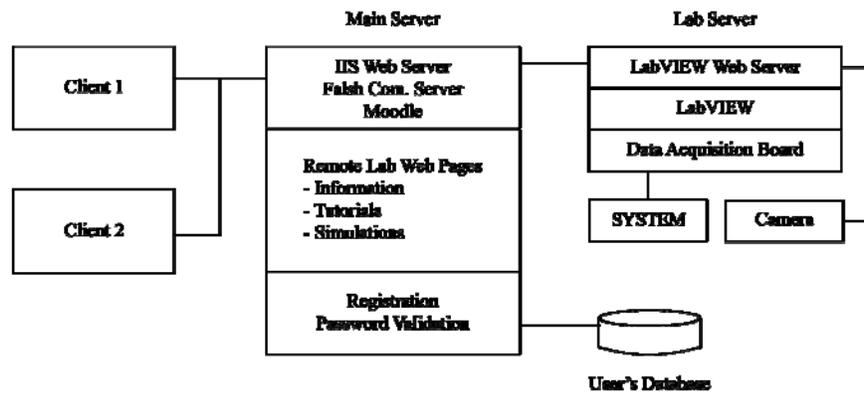


FIGURE 2
FEUP MORE COMMON STRUCTURE FOR REMOTE LABS

remote laboratory concept also provides a tool to bridge the gap between university research and science teaching at school level.

The System Architecture

At present there are some developments aimed at improving the system architecture for better performance as is the case of stability, universality and also at cost systems level, intended to be based on freeware solutions. The most commonly used system architecture is presented in Figure 2. This is the system architecture used at FEUP.

The Microsoft Internet Information Services (IIS) main web server contains all the information on the available experiments (system constraints, short explanation, how to use, videos, simulations, quizzes, booking system and the experiment access) and a database for users' authentication purposes. After user system validation process, the experiment may be scheduled using a PHP interface between the computer user application and the Moodle platform [15]. Some experiments with higher requirements in real video images use Axis, Panasonic and Trendnet IP cameras via an embedded Linux video server. These IP network cameras provide the image directly to the web page of the corresponding experiment. The server also runs the Macromedia Flash Communication Server to control images delivered by webcams used in other experiments with less requirements in video images. Using a dedicated computer for each experiment the software LabVIEW is used with the respective web server. The hardware for communication between the PC and the real experiment is from National Instruments input/output (I/O) cards. Figure 3 shows the Remote Lab web page of the institution at the address: <http://elabs.fe.up.pt/>.

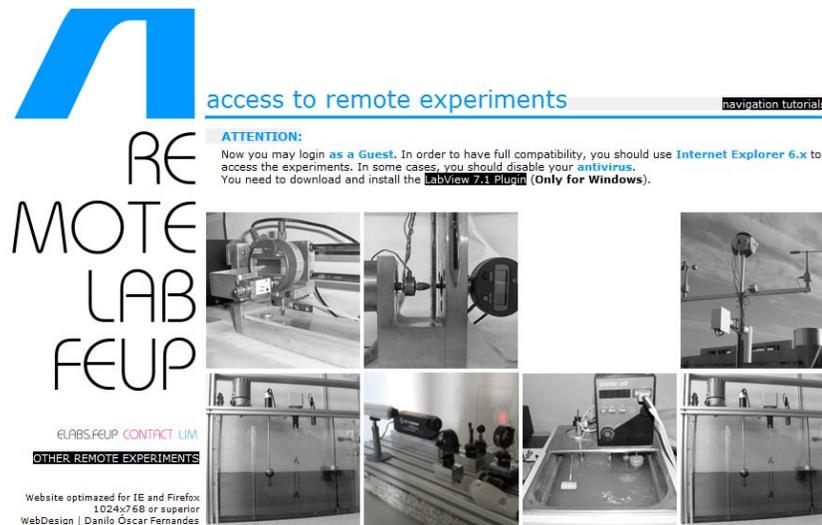


FIGURE 3
A REMOTE LABORATORY WEB PAGE -
[HTTP://REMO TELAB.FE.UP.PT/](http://remotelab.fe.up.pt/)
(ELABS.FE.UP.PT)

FEUP has declared the readiness to share its online experiments and to collaborate to be able to assess the adequacy of the setup and achieve more efficiently the purposes for global use, either on the complementary laboratories' written contents – and the pitch of the tutorial materials aimed at the right knowledge development stage of the users – or on improving the technology used for better performance of the experiments.

E-LEARNING IN PERVASIVE DISTRIBUTED LEARNING ENVIRONMENTS

We have seen the tools used in education from blackboard and chalk, paper and pencil, printed books and photocopies, radio and television, evolve based on modern information and communication technologies (ICT). The introduction of ICT into education has resulted in enhancing the paradigm of predetermined times and places and ways of learning with the new one of learning anytime, anywhere and anyhow. The integration of more functionality means bridging the gap between the teacher and student space using online technologies. We see the linking of learning resources provided by libraries and VLEs turn into a complete digital learning environment at institutional level to provide integrated access to all resources and activities related to teaching and learning [3].

The factors affecting e-learning systems development and implementation, amongst others, include policy of the institutions, the level of IT literacy and the type of curriculum for which the system is intended. Despite the economic crisis which in some countries continues to bite, the learning management systems' market is still continuing to grow. The availability of free OER systems and software has meant increased uptake in their use-learning to promote access and widen participation. The issue remains with the level of IT literacy among learners and access to broadband and associated facilities to access the internet. Some institutions still have a policy that permits restricted adoption of e-learning in some fields of study. With ongoing promotion of digital inclusion agenda in countries like the United Kingdom as well as in some other European countries, it is important that the issues are addressed and the problems resolved.

TRENDS OF DEVELOPMENT AND FUTURE DIRECTIONS

The value of information is increasing in higher education. E-Learning has made it possible for students to be able to choose education providers and mode of access to their field of study. Universities and further education establishments could explore investing in shared databases over the internet so that more Information would be available to learners. Students could then choose or be directed to education courses based on their preference. This will give rise to improved access to education and enhance personal and professional life. We see a rise in the demand for education in a bid to achieve the eight millennium development goals (MDGs) of the United Nations (UN). This in turn has resulted in increased education requirements to which technology offers the answer [16]. Distance education and e-learning offers tremendous cost savings in reduced travel cost and facility utilization. The multiple purposes of universities have been identified to include preparation of students for the labour market; preparation of students for a life as active citizens in a democratic society; personal development of students, and the development and maintenance of a broad, advanced knowledge base [17].

The future will see more and more modules developed and made available via the internet and intranet. The internet will allow access from homes, private offices, libraries, or learning centres. This will remove space and time boundaries. Video conferencing and

interactive videos will be used to extensively enrich the information supplied for instruction and learning. This in turn will provide for more effective education for the learners. Each learner will be able to progress at a pace best suited to the individual or a cohort engaged in the education process. The use of discussion groups provides for active learning. The digitization of information and the availability of digital libraries all over the world via the internet and intranet will be commonplace. Older publications dating back to centuries will be available online, providing data and a rich history for understanding current issues and situations for both the students and institutions. The cost benefits for e-learning are positive for many fields of study [18-22]. As different fields of education are integrated, knowledge and information from remote or global database systems will be made available through the internet. Such internationalization of education information via network technology will be seamless and lead to improved and sustainable development, communication, improved living standard and the global economy. Self education could become a common phenomenon, enabling the branding of individual or industrial qualifications that meet the needs of specific sectors.

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