
E-learning: research and applications

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Abstract

Emerging digital technologies and increasing interest in the computerized delivery of higher education have led to e-learning through electronic mail, the Internet, the World Wide Web (WWW), and multimedia. Issues such as the confidence with which college faculty integrate technology in their teaching, plagiarism and communication remain as important unresolved questions. Considering these, the marketplace of learners is not responding to e-learning as anticipated. Understanding the importance of information systems, and of efforts to ensure that faculty use technology, as well as recognition of the marketplace, a framework has been developed for success with e-learning. Reviews the selected definitions of e-learning. A critical review of literature is provided with a view to developing a more practical framework for achieving success in e-learning. Also, some reported case experiences are briefly discussed. Suggestions for future research are presented.

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1. Scope of e-learning

Electronic learning (e-learning) is gaining an educational foothold all over the world. The availability of electronic and Web-enabling technologies has tremendous influence on the success of e-learning (Kramer, 2000). The Internet and network-centric computing give a strong foundation for experimentation with e-learning and extend traditional learning methods through electronic and Web technologies into new dynamic learning models (Eckert *et al.*, 1997; Colette, 2001). The importance of advanced electronic technologies, such as the Internet, to education has increased significantly during the past few years. For electronic learning systems to make use of these technologies so as to be successful, effective and of a quality comparable with some of the traditional educational learning systems, the electronic learning systems must be designed and constructed with care, using a scientific approach which embraces well-designed procedures and techniques (Colette, 2001).

The e-learning market covers the academic, corporate and consumer fields, and has a variety of segments, including content providers, technology vendors, and service providers. Morgan, Keegan & Co. estimate that expenditures on all forms of education now exceed \$750 billion in the USA and \$2 trillion world-wide, with revenue growth for e-learning expected to outstrip that in all other sectors of the education industry (Cisco Systems, 2000; Fry, 2001). The US Department of Labor estimates that corporate e-learning revenues are expected to increase from US\$550 million to US\$11.4 billion, a projected 83 percent compound annual growth rate between 1998-2003 (Cisco Systems, 2000). A venture capital provider estimated the US market capitalization of the listed corporations involved in e-learning as US\$50 billion, a figure which should reach \$US200 billion in three years (Lance, 2000).

Corporate and campus agendas have started to recognize e-learning as having the power to really transform the performance, knowledge and skills landscape, so much so that the International Data Corporation estimates that the corporate spend on e-learning alone will increase from \$1bn in 1999 to over \$11bn in 2003 (Henry, 2001). Education and training is poised to become one of the largest sectors in the world



economy. Merrill Lynch estimates global expenditures of education and training at over US\$2 trillion. About one third of this spending is in North America, half in Europe and the other developed market economies, and 15 percent in the developing world (Clarke and Hermens, 2001).

E- and distance learning success is a mixed bag. Technology has eclipsed the ability and motivation of institutions to support it. Many early adopters have failed. The marketplace still demands traditional methods of delivery of instruction. It is, however, apparent from the literature and collective experience that improved instructional delivery is necessary. Thus, technology, research and the marketplace are leading the academy to a significant paradigm and cultural change (Mangan, 2001).

Education and training facilities at a distance have long been recognized as a means of providing access to knowledge and learning facilitation to those for whom it might otherwise be denied (e.g. persons engaged in part-time employment or living in remote rural communities). In recent years, the advent and widespread use of information technology (IT) and, in particular, the mass popularization of the Internet/World Wide Web (WWW) have meant that opportunities have been identified for developing distance learning activity into a more advanced online environment (Furnell *et al.*, 1998). Alexander (2001) believes that using technology in both classroom and distance learning will produce these advantages:

- improving the quality of learning;
- improving access to education and training;
- reducing the costs of education; and
- improving the cost-effectiveness of education.

Organizations within both the public and the private sectors are adopting Web-based technologies at an unprecedented rate. The delivery of workforce learning and performance support are among the most promising opportunities these technologies offer for improving business operations. However, e-learning is growing at such a rate that, as in many other business areas, there are less scrupulous companies which are only interested in selling their product, whether or not it is suitable for the purchasing organization and its network capabilities.

Young (2001) provides companies with the inside knowledge they need in order to ask the right questions when entering discussions with e-learning providers, so that they may make an informed decision about whether e-learning is realistically achievable within their specific organizations, building on the success of intranets and the Internet to share information, deliver service and transact business with their customers and suppliers. Corporate intranets have proved to be breakthrough models for communicating information and providing services to employees on a world-wide basis. Extranet is the most common term used to identify this extension of intranet-based applications and services to identified external users (Young, 2001).

Intranets and extranets offer a very capable platform for delivering a comprehensive learning and performance support environment, providing individual workers with access to:

- interactive self-paced multimedia instruction;
- assessment of knowledge and skills;
- performance support materials such as references, job aids, etc.; and
- online communication with instructors, experts and colleagues.

Within this Web-enabled environment, individuals can access courses, individual topics and performance support resources any time – from the office, at home and while travelling. Standard Web browsers offer a consistent and seamless user interface across a wide variety of workstation platforms and networks (Young, 2001).

In the 1990s the textbook publishing industry underwent a dramatic change. To keep pace with the demand for educational materials in all types of media, textbook packages changed to include not only an instructor's manual, but also 1,000 exam questions, PowerPoint presentations for use in lectures, CD-ROMs, and more.

Increasingly, professors requested the opportunity to create their own textbooks, or at least to include articles of their own choosing in course-packs. Others sought materials available online (Antonucci and Cronin, 2001). According to Antonucci and Cronin (2001), in the last few years the number of adults seeking higher education has exploded. The percentage of older

students in college and university programs rose sharply from 32 percent a generation ago to 59 percent by 1999. The primary alternative for students who find travel to a campus difficult has always been traditional correspondence schools. However, as of 2000, half of US households have access to personal computers at home or in the workplace. The Internet is an incredible resource for increasing access to learning.

In a “pure” distance learning system those learning are remote or at least seldom, if ever, see those doing the teaching. They normally practice their study at times and in places which suit them and these times are quite independent of times and places which suit the teachers or trainers. Nonetheless it is possible for those learning in a distance learning system to get help and advice. Among the methods available for delivery of training to the learner are:

- correspondence tuition;
- computer-based training (CBT); and
- interactive video (IV).

The use of distance teaching/learning provides training “round the clock” and trains large numbers quickly (Coffey, 1998).

A serious issue is that employers normally rank skills and technical expertise as 6-8 on a 10-point scale. Generally interpersonal, team-working and analytical skills are rated higher. Thus, electronic delivery of instruction may be limited to content and not be capable of addressing those particular needs of employers. Even so, it is possible to see differences in traditional instructional methodology and to measure them with the total catalogue of company needs.

The formation of the paper is as follows: The current Section presents scope of e-learning. Section 2 deals with the selected definitions of e-learning. A brief review of selected literature on e-learning is presented in Section 3. A framework for the success with e-learning along with critical success factors (CSFs) is presented in Section 4. Finally, Section 5 presents the summary of findings and conclusions.

2. Definitions of e-learning

e-learning is Internet-enabled learning. Components can include content delivery in multiple formats, management of the learning

experience, and a networked community of learners, content developers and experts. E-learning provides faster learning at reduced costs, increased access to learning, and clear accountability for all participants in the learning process. In today’s fast-paced culture, organizations that implement e-learning provide their workforce with the ability to turn change into an advantage. E-learning delivers accountability, accessibility and opportunity. It allows people and organizations to keep up with changes in the global economy that now occur on Internet time. E-learning will be the great equalizer in the new century. By eliminating barriers of time, distance, and socio-economic status, individuals can now take charge of their own lifelong learning.

Countries and organizations must adapt to the demands of the Internet economy to stay ahead in an increasingly competitive world marketplace. The following are challenges:

- countries must educate their citizens;
- businesses must train their workers; and
- educational institutions must offer innovative programs.

There are two fundamental equalisers in life – the Internet and education. E-learning eliminates the barriers of time and distance, creating universal, learning-on-demand opportunities for people, companies and countries (John Chambers, president and CEO, Cisco Systems (see <http://www.cisco.com/warp/public/10/wwtraining/elearning/elearning.html>)).

In the information age, learning opportunities span a lifetime – from childhood to adulthood. Our skills and knowledge need constant refreshing to keep up with new technologies and trends. E-learning empowers us to know more and learn, learn faster with less cost, and to harness the power of information and knowledge. E-learning results in greater productivity, increased profitability and enhanced employee loyalty. Overall, it provides information from a greater variety of sources, increased access to knowledge for lifelong learners, improved quality of services, and rapid adoption of new information and new programs.

3. Literature survey on e-learning

The literature available on e-learning has been reviewed under the classification of

theory of e-learning and practice of e-learning. The articles are reviewed for their contribution and their critical issues. Also, some of the deficiencies are highlighted with the objective of developing a framework for success with e-learning.

3.1 Theory of e-learning

The conceptual framework and some theories of e-learning are discussed to provide a better understanding of e-learning including distance learning. The purpose of linking distance learning is that e-learning is an integral part of distance learning.

The traditional view is that live training is the only suitable means of delivering sales and management training. Companies fail to consider distance learning as an alternative-or-addition-to, so that management and staff development programs can be even more effective. The principal advantages of distance learning are flexibility, cost savings, and more efficient use of time and staff motivation. It can be more effective – people learn at their own pace and retain more information, staff are far more likely to accept ownership and learners are more proactive. For the company, acceptance of the merits of the training and development message at all levels brings positive changes to company culture and philosophy, introducing the concept of being “a learning organization” and providing the further advantage of boosting staff morale and motivation (Tarr, 1998).

Innovation is often the result of interaction of various subjects, technologies, people and organizations, and it is the learning that is derived from such interaction that underpins innovative activity. SMEs are better able to innovate when they are part of clusters, because it is through the networking process and the management of externalities (key elements in clustering) that they develop new products, processes and services (Mitra, 2000).

Daniel (1997) and Johnstone (1992) believe that the use of information and communication technologies (ICT) in teaching and learning will provide at least part of the solution to many of these issues. They argue that technology provides the most fertile ground for growing these key ingredients of university renewal; lower costs and unique attractions. Henry (2001) argues that successful implementation of e-learning requires the same management commitment

as other mission-critical organization-wide initiatives. Most of all, e-learning needs to be compelling to the audience it targets, offering the learner a resource that is seen to be appealing, valuable and productive to their goals and aspirations.

The concept of a learning organization has been given much attention in the organization literature for over a decade. Patterson (1999) discusses the ideas of learning organizations and applies it to universities, suggesting that they adapt to the changing environment and that they become learning universities. The author identifies developments in national policies, increases in student numbers and demands for increased efficiency as factors necessitating change. He also outlines the idea that universities are making cross-sectoral alliances, lessening the distinction between university and non-university sectors. A range of models (Contract, Brokerage, Collaborative, Validation, Joint Program, Dual-Sector Institution, Tertiary university, Metamorphic, merger, federal models) and modes of integrating post-secondary education into university education are discussed, using case examples for each of the model types. He concludes that the emerging comprehensive universities developed from strategic alliances are organizations that both learn and institutionally foster learning.

Multi-campus/large-scale distance learning initiatives increase the complexity of issues, and affect the impact of various quality factors that must be considered in the design and implementation of programs. The impact and interactions of distance education quality factors differ when designing large-scale versus smaller-scale distance learning programs. Vines (1998) presents various quality considerations within a large-scale model, and looks at how decisions were made to ensure quality in the design of the California Virtual University (CVU).

Alexander and McKenzie (1998) reported that e-learning would fail for the following reasons:

- overly ambitious in terms of desired outcomes for the budget and time available;
- utilized particular information technologies for their own sake, without sufficient regard for appropriate learning design;

- no change in the assessment of learning to suit the changed learning outcomes;
- commenced software development without adequate planning;
- failed to prepare students for participation in learning experiences such as working in groups; and
- failed to obtain copyright clearance.

The US Institute has proposed a series of benchmarks for ensuring e-learning quality and evaluating program effectiveness for higher education and policy. These include a documented technology plan, with password protection, encryption, back-up systems and reliable delivery; established standards for course development, design and delivery; good facilitation of interaction and feedback; and the application of specific standards for evaluation (Cisco Systems, 2000).

It is the judgement of Cooke and Veach (1997) that integrating communication can enhance information systems learning from an enterprise management view (e-mail) capability provided by the Internet with paper-based material. Furthermore, development of a balanced integration of electronic and paper-based material as a distance education package is recommended for consideration within other disciplines.

3.2 Practice of e-learning

Garrison and Borgia (1999) focus on the development of an Internet-based distance learning model for teaching the introductory course in the Finance Department at Florida Gulf Coast University (FGCU). In this Internet-based course students are required to participate in a “boot” for the first weeks, which covers only the most complex aspects of the course. After the initial period, the course is completely Web-based in design. The Web page for this course (<http://www.tmag.com/sgarrison/courses/fin3240d/index.html>) contains a variety of pedagogical materials to help students learn and comprehend course content.

Since separating from the AT&T Corporation in 1996, Lucent Technologies, Inc. has become one of the world’s leading designers, developers and manufacturers of communications systems, software and products. A key business imperative for Lucent Technologies, of course, is to keep abreast of its ever more aggressive global competition. The leadership of Lucent

strongly believes that the core of its competitive advantage is the up-to-date skills, knowledge and commitment of its employees, world-wide. Consequently, the Learning and Performance Centre was created at the inception of the company and has been charged with providing the learning solutions that individuals and organizations within the company need for success. Harrod and Townsend (1998) describe the approach that has been adopted to link learning and development to business needs, to deliver learning opportunities where and when they are needed via technology, and to access the impact of learning programs on business results.

KnowledgePool (<http://www.knowledgepool.com>), the e-learning, IT and business skills training company, is further expanding its Internet-based training with the introduction of a preferred learning style evaluator through its training site.

KnowledgePool, in partnership with Insights Learning and Development Ltd, now offers students an online evaluation system that explores their individual strengths and weaknesses. The Insights Discovery System Evaluator and Report assesses personality, decision-making and communication styles. Through the evaluation system, students are equipped with the knowledge of their preferred learning styles before embarking on any training. KnowledgePool provides a variety of features and resources through its training service that are applicable to each learning style. A tele-coaching session with an accredited insight facilitator can also be purchased to help students understand the report and how it can help their job search or training needs.

“E-learning has predominantly been a ‘one-size-fits-all’ approach”, says Paul Butler, chief executive officer of KnowledgePool. “We believe that the preferred learning style evaluator will not only help individual students learn more effectively, but also motivate them to learn by building a “road-map” based on their individual psychological type, and their learning preference.”

Butler adds: “By suiting students’ personalities and providing the motivation inherent to their learning styles, we believe that students are more likely to utilize, retain and seek additional learning when these tools and methods are applied.”

The Insights Discovery Learning Styles Assessment is a ten-question evaluator by which students rate various characteristics. Insights provides a report based on those answers. At its most simplistic level, Insights defines four psychological styles, each with its own approach to learning:

- (1) *Cool blue*. Cautious, precise, deliberate, questioning and formal. Learning style: theoretical, give me the details, intellectual, thorough processing research.
- (2) *Fiery red*. Competitive, demanding, determined, strong-willed and purposeful. Learning style: action-oriented, get to the point, practical action, mediate, fast.
- (3) *Earth green*. Caring, encouraging, sharing, patient and relaxed. Learning style: reflective, give me time to review structured activities, stands back, cautious.
- (4) *Sunshine yellow*. Sociable, dynamic, demonstrative, enthusiastic and persuasive. Learning style: experiential, get me involved, interactive, spontaneous and sociable.

“If we are moving to a world of independent learners, then we must teach them how to learn”, said Doug Upchurch, managing director of Insights. “The key to improving e-learning with a preferred learning style evaluation is to then provide learning components within the training that cater for each style, and we believe that KnowledgePool is a leader within this space.”

KnowledgePool’s e-learning service aims to help each of the preferred learning styles and includes:

- 24 × 7 online, industry-certified, live mentors or “e-structors”;
- real-time chat forums;
- extensive, continually updated database of frequently-asked questions;
- dynamic test-preparation assignments with real-time response;
- mentor-monitored message boards; and
- downloadable training materials.

Blackboard.com is used by a large number of university systems in many states to facilitate both on-campus enhancement of courses and the delivery of distance courses. It has an impressive track record, particularly in the state of California, as a simple way to regularize distance course formats across a

campus, so that each offering from that campus has consistency, and to simplify this method of delivery for a wide variety of proficiencies. Webb (2000) comments that: “The technological tools of this generation are tremendously effective in enhancing the distance education course, but they are just that, the tools for delivering a better distance course. Technology is not the purpose for offering a distance course, but it is an excellent enhancement”. The author has used the following steps in developing a distance learning course using computers:

- (1) Is the course capable of standing alone as a valid learning experience for multiple learner profiles?
- (2) Can you clearly define the learner profiles and what the course offers to them?
- (3) Is the course clearly developed in your mind with objectives and goals that are compatible within this medium?
- (4) Have you successfully delivered this course in the traditional classroom, so those standards for measurement are available for you?
- (5) Have you set up a clear process for acquiring points in order to achieve grade success for the students?
- (6) What process will you use to reach the non-performers in a timely fashion, so that your concern and actions to express and enforce that concern are documented and reasonable?
- (7) How will you deliver your talents as a mentor and guide to these learners?
- (8) What will you consider to be the proofs of your success beyond completion of the course requirements?

4. A framework for the success with e-learning

Many people think that EC is just having a Web site, but EC is much more than that. There are dozens of applications of EC such as home banking, shopping in online stores and malls, buying stocks, finding a job, conducting an auction and collaborating electronically on research and development projects.

In a recent survey almost 40 percent of companies were either using or planning to use online learning in the next 12 months. The research, commissioned by BT and Futuremedia for Solstra, examines attitudes

towards online learning among human-resource and training managers in organizations with more than 500 employees.

The study reveals that 21 percent of firms are using or implementing online learning, with a further 18 percent planning to do so in the next year. Of the companies already using online learning, more than 30 percent say that they have seen a fairly significant return on investment. Some 53 percent, however, say that it is too early to tell. The number of firms using intranets has soared by 21 percent in the last 12 months, to 72 percent today. The numbers with access to the Internet have remained constant at around 86 percent. General awareness of the Internet as a means of delivering online learning has tripled from 8 percent in 1998 to 24 percent today. Some 43 percent of human-resource managers have seen online learning in action.

Awareness of the benefits of online learning is high, but there is still a strong perception that it would leave staff feeling isolated. Some 61 percent voiced concerns over this, compared with 65 percent in 1998. But the feeling that online learning would be unsuitable for group work has been overcome, with 52 percent now seeing the collaborative benefits that online learning can bring.

The framework should include the following steps (Boticario and Gaudioso, 2000):

- (1) Develop an interactive and online resource model that should consider the stakeholders at various levels including lecturers, students and tutors in the distance process.
- (2) Develop significant and active learning by stimulating student participation in the use of the different resources.
- (3) Improve and ensure the procurement of the most relevant information and the establishment of the most significant communications for each user type by providing quick, efficient personalized access.
- (4) Promote new ways of communication that facilitate the establishment of working groups of students and lecturers with common interests by increasing the flow of information between all the protagonists participating in the process.
- (5) Stimulate the use of technological resources available among users.

The Web site specifications should include clear and structured documentation on the site's possibilities, search service, updated documentation on the students, and interaction spaces (shared workspace, monitoring people, online annotations, news groups, mailing lists, adaptive interface, communication of events, glossary of terms, electronic bulletin, software repository, documentation).

It has been emphasized that it is possible to support all aspects of the educational process to at least some degree within an online distance learning scenario. At a high level, the key elements can be seen to include the following (Thomas, 1997):

- provision of learning materials;
- providing facilities for practical work (e.g. simulation);
- enabling questions and discussion;
- assessment; and
- provision of student support services (advising).

A framework for the application of the Internet in e-learning is summarized in Table I.

Larson and Bruning (1996) in their study determine the effectiveness of using distance learning technology to teach mathematics. Researchers used qualitative research methodology to explore perceptions in an interactive collaborative satellite-based mathematics course. Their findings indicate that the distance learning format gave teachers access to more resources, is useful for under-achieving students, and is an effective way to implement national curriculum and instruction standards. A professor at California State University at Northridge divided a statistics class, teaching one group traditionally in class and another in an online version of the course using a WWW site, e-mail, and an electronic chat room (McCollum, 1997). The students who took the online course performed better than the others.

In contrast with promising experiences at numerous online educational centers, it has proved increasingly difficult to meet a wide variety of demands of different users, as well as inadequate structuring and the dispersion of Web sources. These sources include news groups, mailing lists, different kinds of pages such as those of institutions, those containing courses, FAQs, lecturers' personal pages,

Table I Application of the Internet in e-learning

Learning areas	Internet applications	E-learning strategies and technologies
Arts	Online classes for arts classes such as language, improving vocabulary and writing skills	E-mail, interactive and animated video on the WWW, exchanging files
Business	Business courses on Internet, group projects, virtual company tours	E-mail, WWW, chat room, news groups
Engineering	Engineering classes on online, virtual laboratory, virtual design, team learning and group projects	E-mail, WWW integrated CAD, hyperlinks, and 3D navigation
Science	Virtual laboratory, design of experiments, collaborative projects	E-mail, WWW, Internet chat room
Medicine	Simulation of surgical operations, diagnosis, chat room	WWW, WebMD, Internet
Agriculture	Treatment of crops from time to time, training and education using WWW	E-mails, WWW for training and education, multimedia application
Law and justice	Practice of law online, communication, simulation games	EDI, EFT, WWW and Internet

practical exercises, distance learning assessment tests (Boticario and Gaudio, 2000).

Furnell *et al.* (1998) consider the requirements for information security within the domain of online distance learning. A generic module structure is presented which represents a high level of abstraction of the different stages of the educational process. They discuss the main security issues that must be considered at each stage.

A framework is critical for developing the capacity strategy to deliver e-learning courses. Provision of the following support and development mechanism constitutes an integral part of an e-learning initiative (Alexander, 2001):

- a vision for e-learning at the institution;
- development of a technology development plan;
- development of faculty workload policies which relate to e-learning;
- maintenance of a reliable technology network;
- facility for providing technology support to staff and students;
- market research support; and
- provision of time release for faculty engaged in e-learning developments.

5. Summary of findings and conclusions

In this article, an attempt has been made to study the definition of e-learning, to review the literature available on e-learning with the objective of bringing pertinent factors to the fore and to suggest a set of critical success

factors for developing e-learning environment.

In a few years' time, current computer technology will be outdated. Clearly, the availability of broadband technology will increase the online learning options by making use of videoconferencing, advanced animation techniques, and virtual scientific laboratories. Electronic books have become more prevalent. Learning opportunities will expand further (Antonucci and Cronin, 2001). There is no doubt that e-learning has an important role to play across all business sectors. In addition to its cost-effectiveness, its main advantages are its flexibility, its convenience to users, its wide reach, its easy accessibility, its consistency and its repeatability. The objectives of e-learning are dependent on the quality of the teaching process and the effectiveness of online access.

Several script languages and Internet-oriented languages have been used to embed interactivity into Web pages (Hall, 1998), including Java and JavaScript. Among them, Java is the most powerful tool to make Web pages interactive. This is because it is a proper object-oriented language, platform-free, and has more functionality than its competitors. Actually, programming the Web with Java remains the hottest topic of recent years, in both the academic world and the computer industry. Java applets embedded into Web pages can be run on all kinds of computer systems, so long as machine-dependent Java virtual machines have been installed (Tian, 2001).

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