

Creating an Effective Learning Environment through an E-Learning Instructional Programme (ELIP)

Maria Jakovljevic

mariaj@flamewave.net

University of the Witwatersrand

School of Economics and Business Sciences, Johannesburg, South Africa

Abstract

Though numerous research reports have provided a body of information about benefits of e-learning there are barriers such as, asynchronous communication channels, lack of personalisation, which decrease the level of interaction between the learner and instructor [13],[14]. The aim of this paper is to discuss and outline a framework on e-learning pedagogical and technology issues which provide a basis for the creation of an e-learning instructional programme (ELIP). The Phase I of this research start with the creation of a framework for an e-learning environment and derivation of the e-learning instructional programme (ELIP). Phase II is aimed to implement a popular audio playback device (iPod) and VoIP. In this phase 40 learners, one instructor and three tutors will be observed and their experiences will be evaluated through focus group interviews and documents analysis. This research was based on a qualitative research approach [44],[78].

Keywords: e-learning technologies, iPods, VoIP, learning communities, human network, instructional program, e-learning content, concept maps, knowledge management

1. Introduction

The rise of e-learning technologies is evident in education all over the world [11],[14],[15],[60]. Communication and application-sharing technologies have a great impact on informal and formal education (Higher Education Policies for the Digital Age, [25] cited by [38], [29]), particularly through the use of mobile and wireless technologies [48].

E-learning eliminates the barriers of time and distance, creating universal learning-on-demand opportunities for people [63]. However, learners using e-learning have high anxiety levels since they cannot actually see the faces of their instructors to get an indication of whether they are meeting their expectations.

The imperative in South African education is that any learning context should be learner-centric and learners should be creative problem solvers [17],[18],[19]. There is a general tendency to establish an effective e-learning environment in South African universities, where web-based learning has been predominantly in the form of online text, email communication and posted course assignments, as well as chat, which has given learners greater asynchronous opportunities to interact with one another, usually from a desktop.

Researchers agree that e-learning technologies are only channels for delivering learning content with the focus on the cognitive, behavioural, and physiological interactions [70:3]. These authors agree that pedagogical methods using even the simplest technologies can be highly effective [70],[71],[72]. Sheard [64:38] points out that despite increased use of online communication, the underlying pedagogical issues to support their use have not been developed concurrently.

The researchers, Teo & Gay [70:1], also point out that although the barriers of time and space have been eliminated by technology, the learning paths are still rigid and restricted. The reusability and learner personalization, which could be the most important aspects of e-learning, have not been exploited to their full potential.

There is little in the research literature on appropriate instructional strategies, which could address motivational, emotional and cognitive aspects of e-learning, as well as physical barriers between the learners and the instructor.

This study discusses a variety of e-learning issues forming a framework for e-learning and develops an E-Learning Instructional Programme (ELIP). The aim is to improve both the learning experience and the learners' problem-solving skills. Furthermore, the aim is to assess pedagogical success in using e-learning technology [34] in an organized instructional framework as measured by learner experience and performance.

This study is divided into two phases: In the first phase, the framework for an effective e-learning environment is established, culminating in the development of an ELIP. The following research questions were set for the first phase:

1. *What is the learners' attitude in participating in the research?*
2. *What are barriers in establishing adequate e-learning initiatives?*
3. *What are the necessary pedagogical issues for the creation of an effective e-learning environment?*
4. *What are the crucial components of the ELIP that can promote problem-solving in the e-learning environment?*

The first phase has already been initiated and preliminary results have been analysed.

In the second phase of the research, e-learning technology such as iPods and Voice over IP (VoIP) in the form of the application Skype will be implemented in a qualitative data-gathering exercise to ascertain the answers to the following research questions:

5. *What is the extent of the impact on the learner's learning and cognitive abilities through the use of iPods in providing audio lectures in an online environment?*
6. *How do the learners feel in terms of their confidence in the new technology and their ability to research online?*
7. *How often and for what duration do learners use iPods and VoIP software for their study during the semester?*
8. *What are the experiences of the instructor in terms of the ELIP and e-learning technology?*

This article is organized as follows: Firstly, the framework for e-learning is discussed, leading to the creation of an ELIP. Next, the research methodology is described and some preliminary findings are given. This article concludes with an overview of a practical instructional architecture and suggested future research.

2. Framework for Creating an Effective E-Learning Environment: A Basis for the Development of the E-Learning Instructional Programme

Instructors and subject matter experts have to place more focus on e-learning issues (current e-learning technologies, the role of learning theories, creating learning communities, the use of extended human networks, understanding the features of knowledge management and how to design and manage information on the web) in order to change the role from dictators of learning experience to promoters of problem-solving skills. These e-learning issues form the basis for the ELIP.

2.1. Current E-Learning Technologies

There is a growing body of literature on the use of podcasting in the form of audio and video files [49],[52] and blogging [11],[20],[23][49] for higher education purposes. iPod technology (21), known as podcasting, is mostly used for recording the audio content of lectures to be used outside an offline classroom.

Podcasting, which draws its name from Apple's iPOD, means broadcasting MP3 audio files over the Web [49]. Researchers have indicated that Video iPods can be used for distributing lectures, classroom discussions, recordings and audio/video file storage.

Learners experience many time constraints [61], particularly the obligation to be present at lectures in the early morning or evening. Textual information is commonly available but requires reading, which can be replaced by iPods and audio material. The introduction of iPod technology could satisfy these learners' constraints and needs to a significant degree.

VoIP telephony applications, such as Skype [66], enable users to communicate orally at low cost or no cost. A growing number of universities are using these devices to extend their e-learning services (Duke University [21], cited by [49]).

Researchers (for example Kurtz et al. [34]) indicate the efficient use of Tablet PCs in different subject areas and present some indication of their usefulness for problem-solving exercises in the field of computer science.

Wireless networks [48] and laptops have many advantages for multiple communications and sharing knowledge between learners, involving the instructor, and creating a peer-based learning environment [8], [47].

Synergy among multiple channels of communication could support interaction (both synchronous and asynchronous), which in turn could support greater use of the technology in building a distributed learning community and enabling more innovative teaching activities [57].

2.2. The Role of Learning Theories in an E-Learning Context

The e-learning area requires an instructor to be well versed in various integrated themes of learning. A challenge for instructors is to focus on various learning theories, such as, constructivism (for example, Bednar, Cunningham, Duffy & Perry [4]) and the action theory [36]. This could offer the basis for an enriched e-learning experience.

2.2.1. The action theory

Leontjev [36] defines three different levels of learning action throughout the completion of a learning task, such as, skills-based action, rules-based action and knowledge-based action. On the first two levels of action the control is a feed-forward type. It is not necessary to provide new information or feedback other than practice. However, on the knowledge-based level there is a need for feedback control. Through prompt feedback learners recognize their mistakes and this improves their performance in future tasks.

2.2.2. Constructivist learning theory

Constructivists state that the knowledge domain may be specified, but the learner is encouraged to search for new points of view and gain understanding from multiple perspectives [4]. Constructivism supports a situated cognition perspective, as well as a cognitive apprenticeship perspective on learning and instruction [27]. From the *situated cognition perspective*, learning always takes place in a particular context [7]. The context forms an inextricable link with the knowledge embedded within it [68]. The main goal of such an approach is to make the learner think like an expert. *Cognitive apprenticeship* as a constructivist perspective states that the constructivist instructor must model the pattern for learners and coach them toward expert achievement [27].

2.3. Necessity of Creating E-Learning Communities

Learning communities or "communities of practice" [59] can be powerful vehicles for personal growth and learning. Knowledge is developed collaboratively based on common interests, practices, tools, discourses, and shared values, goals, and activities [50],[55],[59]. Consciousness and meaning are always formed in joint, collective activity [36]. McLoughlin and Oliver [42] suggest that "social feedback from peers may be more helpful than direct corrective feedback from an instructor".

Online discussion forums enable the development of electronic learning communities [64]. Various studies have proven the importance of providing facilities to enable learners working online to interact with other learners and with their educators [37],[41],[26],[75].

Stacey and Rice [69:339] point out that “tasks designed for online discussion generated online interaction with a cognitive focus”. Nanlohy and Munns [49] proposed that educators should be active in organising and monitoring online discussions that promote social support and the acquisition of knowledge. If no guidelines are provided for the discussion forums, the use of the discussion space could be purposeless. Mediation for learning takes place via people and tools [1]. Creating e-learning communities and online discussions forums could help to overcome the asynchronous barrier in online interaction between learners and instructors [64].

2.4. Overcoming Barriers to E-Learning with an Extended Human Network

Dagada & Jakovljevic [13],[14]) identified inadequate access to technical advice, lack of expertise and support as factors hindering successful e-learning. If a network of human resources (a teaching assistant, a senior tutor, peer-tutors, technical assistant) is available to assist the instructor, it is possible to overcome these barriers and create an effective e-learning environment:

- a. *A teaching assistant*, who prepares for individual guidance and group tutoring in a time and place convenient for the learners, should have a proven record of knowledge and skills in the subject area [27].
- b. *Peer-tutors* teach a topic, skill or concept to members in the group or across the different groups according to a time schedule. The tutor can answer many of the coding and assignment questions and manage large volumes of online posting [27],[64].
- c. *A technical assistant* is an expert who can provide specialised technical knowledge and skills in terms of software and hardware [28].

2.5. Designing E-Learning Material and Managing Information on the Web

Paper-based course materials are usually mounted directly on the web in digital format [58] that does not support online interaction. According to Sheridan and Ferrell [65], information is usually presented at a fast rate and humans cannot absorb speedy presentation. The amount of information should be limited to seven, give or take, two ideas (Miller [46], cited by Mende [43]). Selim [63] notes that videoconferencing mediated instruction could be of benefit to effective presentation in an e-learning context.

Volery and Lord [75] state that both the technological competence of the instructor and learners and an appropriate interface design contribute to satisfactory e-learning outcomes. However, instructors avoid designing instructional-interactive web pages, as this requires technical knowledge, time and energy.

One should consider new methods of presentation and creation of interactive learning materials [39]. MacKnight [39] suggests a solution in distributing quality on-line materials such as the *Educational Object Economy (EOE)* [3]. This provides an opportunity to contribute and share Java-based learning objects over the Internet; anyone can add an educational object to the data base.

As the basis for successful e-learning and management of information on the web, instructors should consider students' acceptance of e-learning. Selim [62], in his e-learning acceptance model, highlights critical success factors such as the instructor's characteristics, IT infrastructure and support, which all influence students' acceptance of e-learning.

2.5.1. Intelligent agents

Kristensen, ([33]: cited by Kristensen and Lamo, [32]) point out that learners derive most benefit from using different types of *intelligent agents* in the learning process. Intelligent agents act on behalf of the user and roam the Internet, looking for relevant information that the user might want [56], [76]. Intelligent agent's strength is their capability to add value to information by way of summarisation and analysis [9]. Intelligent agents involve the scanning and comprehension of text which, after summarisation, is routed to users as information.

According to Belford and Furner [5], intelligent agents offer a better solution by being autonomous with regard to the data they require about the environment, and having the ability to learn about users' personal preferences. Jones and Thomas [30] point out how individuals employ personal information management. An intimate consideration of the medium of the chosen tool, its characteristics according to the needs of the individual (i.e. spatial or visual recall), is crucial in personal information management.

2.5.2. E-learning knowledge management: a concept map approach to visualize knowledge representation

Teo and Gay [70:2] state that knowledge results from processing the information on the web, but that the information per se is not really knowledge. They propose a concept map approach to visualize knowledge representation and to illustrate how the personalization of learning can be achieved [70],[72],[73].

These authors propose the concept of a map-based knowledge model, which makes use of the visual aspect of concept maps to depict, visualize and manage the structure of the knowledge rather than the knowledge itself. The knowledge structure should be seen as an externalization of the experts' cognitive structure.

Berners-Lee et al. [6], cited by Teo and Gay [70]), highlight the use of the semantic web, through which information is given well-defined meaning, to enable computers and people to work cooperatively. It is simply a web whose content can be understood and processed by computers or software agents.

These knowledge structures can be seen as a form of visualizing the subject matter expert's tacit knowledge, a term coined by Polanyi ([51], cited by Teo and Gay, [70:5]), who encapsulated the essence of tacit knowledge in the phrase; "*we know more than we can tell.*" Davenport & Prusak [16] specify that "the more rich and tacit knowledge is, the more technology should be used to enable people to share that knowledge directly".

Because of the lack of an organised instructional environment and personalisation [70],[71], it is important to establish a sound e-learning instructional environment.

2.6. E-Learning Instructional Programme

The researcher has developed an instructional web-designed programme, which was applied in an offline project-based classroom [27]. This programme has been modified to serve the needs of learners and instructors in an e-learning context. In addition, the e-learning issues (e-learning theories, e-learning communities of practice, intelligent agents, e-learning material, e-learning knowledge management) discussed above serve as a basis for the development of an ELIP containing components necessary to support online teaching and learning.

Outcomes-based Education in South Africa and the concepts of the Illustrative Learning Programme [19], as well as the roles and competencies of the instructor in a technology classroom, serve as the further basis underlying the derivation of the ELIP [27]. Policy related to Outcomes-based Education in South Africa highlights the necessity to meet the critical learning outcomes [18],[67] and specific learning outcomes [27] in any learning area.

The ELIP consists of the following components (adapted from Jakovljevic [27]):

- The stages of the technological process. The technological process includes the following twelve stages: Statement of the problem; Design brief; Investigation; Proposal; Initial ideas; Research; Development; Planning; Realisation/Making;

Testing, Evaluation and Improvement. The stages of the technological process are cyclical and repetitive [40],[27].

- *Theme*.
- *Critical outcomes (COs)*: COs are generic cross-curriculum outcomes, which ensure that learners gain the skills, knowledge and values that influence their own success and contribute to a wider community [17].
- *Specific outcomes (SOs)* include technological knowledge, skills, attitudes and values that help learners to understand and demonstrate achievements in technological contexts.
- *Assessment criteria (AC)* help to evaluate the processes (cognitive and behavioural) and indicate in broad terms the observable products of learning.
- *Range Statements (RS)* indicate the scope, depth, and level of complexity of content, processes and context learners should engage with, as well as the parameters of achievement [18].
- *Performance indicators (PI)* assist the instructor and learners by providing details of the content and processes that a learner should master.
- *Case study tasks* help learners to connect classroom activities with the community.
- *Resource tasks* guide learners through a variety of means (graphic techniques) through which they build technological knowledge, creative, reflective and problem-solving skills.
- *Capability tasks* spread across the stages of the technological process, which help learners to apply the acquired knowledge and skills
- “Notional time represents contact time, learners’ efforts and time, preparation time and other issues” [18].
- *Learner off- and on-line activities* are allocated for each task.
- *Instructor activities (Instructional strategies)* [1],[2],[27],[54].

The stages of the technological process enclose these components so they are structured in an organised manner. Learning support can be facilitated through a set of learner tasks and online activities. Wheatley [77] points out that being faced with a task for which no known procedure is available creates favourable conditions for learning. Tasks should be given according to the ability level of learners, as well as prior experience [29].

The network of human resources (a teaching assistant, peer-tutors) are organised through the pre-defined set of AC, RS and PI embedded within the ELIP. A variety of pre-defined instructor activities (instructional strategies) were incorporated into the ELIP, guiding the instructor through the complexity of establishing an atmosphere that will stimulate creativity and problem-solving.

Learning outcomes (critical COs) and SOs should be communicated to learners before the implementation of the ELIP. Clear communication on the learning outcomes could improve learners’ intrinsic motivation and individual responsibility during learning. Varieties of learner case studies, resource and capability tasks within the ELIP support different types of learning experience (for example, individual, collaborative, situated learning, inquiry learning, apprenticeship learning, peer learning, observational learning and experiential learning).

3. Research Design

3.1. Qualitative Research Approach

This research can be described as qualitative [10] in view of the exploratory nature of the research questions. It required the description and understanding of the social phenomenon [74] of examining learners’ and instructors experience and opinions with regard to using mobile technologies in learning web programming and design.

3.2. Profile of Respondents, Intervention, Data-Gathering Methods: Phase I and Phase II

The sample of 40 learners was selected on a convenience sampling basis from an institution of higher education in Johannesburg, South Africa. The respondents were enrolled for a diploma in Computer Studies at the time. Learners were divided into ten groups, with three to four learners in each group.

In *Phase I*, ten learners were interviewed in a focus group before they were given iPods. There were eight females and two male learners from a diverse cultural background. The purpose of the interview was to examine learners' interests and attitudes for research into e-learning technology and to assess some constraints in an off-line web-design classroom. The focus group interview lasted 30 minutes. During *Phase I* the computer infrastructure was assessed and organised and the ELIP was developed. A framework was formed in order to commence with the second phase.

In *Phase II* ten focus group interviews with learners will be performed after the use of iPods and VoIP (Skype). In addition, document analysis (project deliverables, individual and group assignments) will be assessed to evaluate learning outcomes. A senior tutor, a technical assistant and a teaching assistant will be involved in monitoring the use of the technology. They will be interviewed individually to examine benefits and constraints in using the e-learning technologies and the implementation of the ELIP.

Individual and focus group interviews will last 30 to 45 minutes and the data will be tape-recorded and later transcribed. Therefore, data will be gathered through multiple data-gathering methods that satisfy the criteria for triangulation [31].

3.3. Assessment of Trustworthiness and Analysis of Data

At all times, care was taken to ensure the trustworthiness of the data [44], by ensuring that the collection and data were both *reliable* (where evidence and conclusions stand up to close scrutiny [53], and *valid* (where the research actually measures what the researcher claims it does) [12].

Data were analysed by way of a constant comparative method, identifying major themes and sub-themes within the interview transcription [44]. This was done using a 'map' of themes, as well as a colour-coding and reference number system. In addition, in *Phase II* the constant comparative method will be applied to the data during interviews and between interviews [44]. The next section discusses the actual findings from *Phase I*.

4. Research Findings: Phase I

Themes were derived from the experience of the respondents gathered through the focus group interview. Four major themes emerged:

4.1. Learners' Positive Attitude to Mobile Technologies

Learners' comments were as follows: "... I think if I use an iPod it will make my learning more clear... I would be able to listen at any time ... I can repeat instructions at home." Another learner commented, "in the classroom is noise or we feel sick or tired ...We are forced to listen and read ... I cannot remember when a lecturer talks in the classroom ...". Another learner said, "We use it to listen to music and it is relaxing ..."

The learners' attitude to the intended research on the use of iPods was therefore positive, although some learners were hoping to keep the iPods in return for performing the research. In a South African environment MP3 players are often used to listen to music and this behaviour is observed on a large scale.

4.2. Some Barriers Concerning Computer Infrastructure

An issue raised by one learner during the interview was: "... *Internet is installed in one computer laboratory ... most of us have no computer at home ... we don't have adequate access to technical advice.*" Another learner commented "*I am completely shocked with support... the technical people are not available*". South Africa is apparently behind in terms of global technology trends. This may be attributed to the lack of financial resources and technical skills of staff. Nevertheless, there were comments that "*our lecturers will make the technological devices more accessible*".

4.3. Expense of E-Learning Technologies

Expense was an important issue. It was acknowledged that "*technological solutions are often expensive... It was, however, agreed that "in the greater scheme of things a lot of the technological solutions are not significantly more expensive than ordinary IT costs"*". One learner, however, made a comment with which the focus group agreed: "... *iPods are not expensive ... it is more expensive to travel to the classroom and wait for transport*".

4.4. Proactive Efforts

Proactive efforts include the essential "*support from lecturers, administrative staff, technical people*" and "*various toolkits*" to enable '*proper handling*' of e-learning technologies.

The respondents accepted that "... *lecturers need to be proactive to improve teaching with iPods*". Innovative ideas included "*repayment or cost-sharing schemes for technology*". Solutions were apparently education, training and support, so that the education bodies can understand the reality of the learners' needs in the new technological era.

This concludes the findings section of the research, which will be tied up further in the discussion section that follows below.

5. Discussion

From the results, and in answer to research question one, in terms of the learners' interest in the use of mobile technologies (iPods), there was no doubt that learners see this opportunity as a form of personalised learning in their own time and place, with the added advantage of being able to repeat content. When using telephony and audio delivery, universities have a potentially cost-effective tool, which can facilitate more interactive and engaging e-learning environments.

Evidence indicates some barriers to e-learning such as inadequate access to technical advice, expertise and support. Most e-learning problems can be solved to some extent through awareness, training and proactive efforts, especially by lecturers, tutors, and technical staff. E-learning initiatives depend on the institution's infrastructure and support and the instructor's characteristics [22],[63]. Research shows that providing blended learning can overcome the disadvantages of e-learning [13], [14]. The instructor's support of the e-learning initiative needs further attention, as misunderstanding is common (in answer to research question two).

Research indicates (for example, Govindasamy [24], Kristensen [33], Kurtz et al. [34], MacKnight [39], Merrill [45], Sheard [64], Stacey & Rice [69], Teo & Gay [70], [71]), that it is necessary to address pedagogical issues in the e-learning arena, such as current e-learning technologies, the role of learning theories, creating learning communities, the use of extended human networks, support by intelligent agents, understanding the features of knowledge management and designing and managing information on the web.

For e-learning to be effective, communication channels must be managed through an organised instructional framework. In answer to the fourth research question the researcher has thus constructed a conceptual programme (ELIP) with multiple components discussed

above, with the aim to create an effective e-learning environment. Crucial components of the ELIP can promote a problem-solving environment.

If an organized instruction is created, the instructor will be relieved from organizational routine when creating and monitoring an e-learning environment. Motivational aspects need to be established in order to ensure that the learners do not “slack off” owing to the added convenience of an e-learning environment. Proper planning of the e-learning programme and evaluation techniques can ensure adequate motivation. In addition, appropriate methods need to be implemented to encourage learners to collaborate with their peers in the e-learning environment.

A solution to asynchronous communication could be carefully planned through regular communication channels/ rules between learners’ and instructors’. Predefined tasks and activities in the ELIP are based on learning theories and provide instrumentally mediated guidance to learners and the instructor. It is necessary to establish regular follow-ups and reminders in the form of SMS or e-mail and to keep in contact on a daily basis. In addition, interpersonal communication should occur once a week.

Help provided by a human network could decrease the instructor’s burden with regard to administration and technical issues. The design of e-learning material depends on the technical expertise of instructors and this can be supported by Internet tools and techniques such as intelligent agents [33], [56]. Not many learners’ have the self-discipline and vision to determine and monitor what is happening in the e-learning journey. Learners should acquire various self-management techniques to manage the information.

6. Conclusion

This paper provided a fresh perspective on e-learning: a discussion on the framework and creation of the ELIP as a solution to overcome or limit some inadequacies in the e-learning arena.

The instructor must bear in mind the limited human information-processing capabilities of learners. Thus, an instructionally driven programme to organize and personalize e-learning was shown to be necessary in this research.

The ELIP could promote e-learning by synchronising the learner’s tasks and activities with the instructor’s activities. The tasks and activities of the learners and instructor are designed according to ten stages of the technological process.

In undertaking an evaluation of current weaknesses of e-learning processes, it was necessary to highlight some pedagogical aspects that could improve these processes, namely the choice of e-learning technology, the role of learning theories, creation of learning communities, use of extended human networks, understanding of the features of knowledge management and design and management of information on the web. Integration of the various pedagogical issues is vital, but demands planning of interaction, mediation and feedback in a learning process. The next step will be the implementation of the ELIP.

The outcomes of this study will have vital implications for creating an effective learning environment, enhancing the problem-solving skills of learners and catering for their limited information-processing capabilities.

Further research should be done on developing an e-learning resource planning system similar to an ERP system and a Voice Portal Service through which e-learners can obtain voice-activated guidance and mediation.

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