

Literature Survey

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1 Introduction

The primary aim of this chapter is to explore the literature surrounding the development of online learning environments. In particular, the focus is on outlining approaches to design and pedagogy that have the potential to facilitate the successful implementation of an effective prototype online learning environment. This investigation begins by providing an overview of the context in which the use of information and communication technologies (ICTs) for education occurs in South Africa. It moves on to define and explore the concept of e-learning. Once this background is established, the discussion concentrates on the development of online learning environments. Firstly, a survey of prominent design theories and features is provided. Secondly, an investigation is undertaken into various techniques that may be used to improve learner engagement. Finally, a brief overview of methods of evaluating the success of online learning environments is offered.

2 Current State of Information and Communication Technology Use for Education

Before any meaningful discussion of the use of online learning environments can be undertaken, it is important to consider the current state of the use of computer technologies to aid teaching in South Africa. This section provides a brief outline of some of the problems currently facing education in South Africa and introduces the possibility of ICT use as part of the solution. It also provides some background on the current state of ICT use in South African and legislation surrounding ICTs in education. From this discussion it will become apparent that the use of ICTs in education faces many difficulties in South Africa, but that there is an emerging confidence in ICT use among South African and world leaders.

2.1 State of Education in South Africa

The former South African Minister of Finance, Trevor Manuel, identifies education as a development area of “particular priority” [19]. The national senior school pass rate for 2008 was

only 62,5% [23]. Many South African schools do not have enough adequately qualified teachers [14] and, according to the 2007 Survey of ICT and Education in Africa, are “under-resourced, under-supplied, and over-crowded” [14]. These impeding factors result in learners not receiving adequate instruction, and not being up to the standard of their final year examinations.

2.2 ICT as a possible solution

The United Nations recognises education as a fundamental way of addressing the issues facing developing countries [26]. Universal primary education by 2015 is one of the UN’s Millennium Development Goals [26]. The former Secretary General of the UN, Kofi Annan, argued for the use of ICTs to “unlock the door to education” [26] and the South African government shares this sentiment. In the 2003 Department of Education (DoE) White Paper on e-education, the DoE argued that ICTs are a powerful tool that can be used to “overcome” the “capacity-related limitations” in the education sector [6]. The white paper outlines a policy framework for e-education in South Africa and sets the ambitious goal of ensuring that all learners are ICT capable by 2013 [6]. It also serves as an acknowledgment from the government to the potential and importance of ICT use in education [6]. Former President Thabo Mbeki stated that ICT is a “critically important tool” in the struggle against “poverty ... under-development [and] ... marginalisation” [6].

2.3 State of ICT Use for Education in South Africa

In order to get a complete idea of the possibilities of ICT use in South African schools, it is important to consider the current state of ICT usage. The e-education white paper mentioned earlier includes statistics pertaining to the use of ICTs in South African schools. It states that only about 6,4% of South Africans in 2003 had access to the Internet, and over 19 000 schools did not have any computers to use for teaching or learning [6]. Table 1 illustrates the percentages of schools, both nationally and in each province, that have computers which are for teaching and learning use.

It is interesting to note that the Eastern Cape has a particularly low figure, with only 4,5% of schools having computers to use for teaching and learning. Wagner identifies some of the obstacles to the spread of ICT use as: a shortage of staff with IT (Information Technology) skills, poor infrastructure (“including power, telecommunication access, and Internet service providers”), and curricula that do not have room for IT skills [27]. He also stresses that it is vital that government policies support the use of ICTs in education [27].

2.4 Legislation

In any country, the state of the legislation surrounding a development issue will play a crucial role in the success of that development [3]. A recent series of international case studies and

Province	Schools with computers, used for teaching and learning
Eastern Cape	4.5%
Free State	12.6%
Gauteng	45.4%
KwaZulu-Natal	10.4%
Mpumalanga	12.4%
Northern Cape	43.3%
Limpopo	4.9%
North West	22.9%
Western Cape	56.8%
<i>National</i>	26.5%

Table 1: Table illustrating the percentages of schools with computers used for teaching and learning use in South Africa. [6]

surveys revealed that successful ICT integration does not arise simply from the presence of computer equipment, but that government policies and implementation plans, along with the necessary administrative and training support, are essential elements in making ICTs effective in an educational environment [27]. The South African government has launched several initiatives that aim to support the improvement of South African education using ICTs. The Presidential National Commission on the Information Society and Development (PNC on ISAD), launched in 2001, serves as an advisory body to the government regarding the best approaches to ICT use [6]. More recently, the Accelerated and Shared Growth Initiative for South Africa (ASGISA) was established. This initiative focuses on ensuring that communications infrastructure in the country is expanded and made more affordable, as well as on the development of critical IT skills development [14].

The 2005 Electronic Communications Act makes provision for a minimum of 50% discount on electronic communication charges and equipment to “all public schools and all public further education and training institutions” [8, 14]. Schools are still having difficulty obtaining this discount, though, meaning that the necessary legislative support is not being enforced [14]. In fact many schools are unable to obtain suitable connections to the Internet, due to a lack of regional infrastructure and funding [14]. The government is making more funding available for the integration of ICT in education, though, which should have a positive impact on infrastructure expansion [14].

3 E-learning

The previous section provided a broad overview of the ICT infrastructure and legislation in place in South Africa. The discussion now moves on to explore the actual practice of using ICTs to aid education. An investigation into online learning environments would not be complete without a background understanding of what online learning, or e-learning as it is commonly referred to in the literature, is and why it is something worth researching. This section aims to provide

a broad definition of e-learning as well as an idea of the kinds of benefits that can be expected from its implementation. It also makes the fundamental point that an implementation of e-learning requires more than a simple transferal of traditional classroom pedagogies in order to be successful.

3.1 What is E-learning?

In order to be able to talk effectively about online learning environments, it is crucial to define the concept of e-learning. Churton defines e-learning as “an approach to facilitate and enhance learning by means of personal computers, multimedia, and the Internet” [3]. It is thus simply a process that uses computer technology to aid learning. The South African DoE explains e-learning in terms of three parallel processes. As the primary process, it involves “learning with” computers - using ICTs to convey, or facilitate the conveyance of, concepts [6]. As secondary processes, learners (a) learn more “about ICTs” themselves, and (b) learn new learning methods “through” their use of computers [6]. E-learning tends to promote an environment where communicating and collaborating is easier, which enables learners to engage with content more actively and creatively [6]. E-learning also has a propensity for allowing the combination of structured content and flexible learning; as well as allowing for the management of individual learning [6]. One of the DoE’s goals is to establish a community of “e-schools”, which can be broadly defined as schools (with access to reliable ICT infrastructure and useful learning resources) where learners use ICTs to aid them in their learning, and teachers use them to aid in the teaching process [6].

An important concept that needs to be defined is that of “integrated e-learning”. Jochems, Merriënboer and Koper define integrated e-learning as a supplement to “more conventional methods” of teaching [15]. The focus of integrated e-learning is not on replacing traditional methods of instruction, but on e-learning as “just one of the methods” involved in “providing optimal learning arrangements by the use of a variety of methods” [15]. At this point, it is also important to distinguish between synchronous and asynchronous e-learning. The term synchronous e-learning describes scenarios where “students and instructors engage each other at the same time,” often from different locations [28]. “Telephone calls, VoIP, live text chat, videoconferencing, and LVCs [Live Virtual Classrooms]” can all be described as synchronous e-learning technologies [10]. Asynchronous e-learning, on the other hand, refers to scenarios where “students and instructors are engaged in ‘anytime-anyplace’ learning” [28]. In asynchronous e-learning, learners are able to access learning material whenever it is most convenient for them to do so [28]. Asynchronous e-learning is therefore better suited to integrated e-learning. For the purposes of this discussion, the focus will be on integrated asynchronous e-learning.

3.2 Benefits of E-learning

One might ask exactly why e-learning is something worth investigating. There are several ben-

efits to using computers to supplement learning. Firstly, e-learning enables a “learner-centred” teaching approach [3]. Because learning happens asynchronously, learners are not constrained by the traditional classroom practice of everyone learning content in the same time period [3]. This means that learners are able to work through content, to some extent, at their own pace [3]. Secondly, e-learning has room for the successful practice of more individual learning approaches and individual needs, meaning that learners are able to engage with content in a manner they feel more comfortable with [3, 6]. Computer networks also make collaboration and discussion easier, which teaches learners how to express their ideas, and learn from one another [6]. Another salient benefit of e-learning is the exploratory approach required to find content on computer networks. Using ICTs encourages learners to be more “active” in their learning: they are required to take responsibility for their own learning, they need to engage with the content more carefully, and they need to develop analytical skills in order to discern whether information is useful [3, 6]. E-learning also exposes learners to a “wider range” of sources, learning environments and learning styles [21]. In terms of e-learning’s impact on pedagogy, it has been demonstrated that, with proper teacher training, adopting e-learning forces teachers to revise teaching strategies and rework content, often with the result that learning becomes more relevant and accessible to learners [27]. E-learning also offers a powerful means of “connecting learners and teachers to each other” as well as to ideas from a broader range of sources [6]. A final prominent benefit of e-learning is that learners and teachers both acquire essential “21st Century skills” [27]. Churton contends that e-learning not only teaches content, but also skill in the use of computer technology, which is an increasingly important modern ability [3]. Kozma takes this idea a step further by contending that the use of computers also introduces learners to other vital modern skills such as “information management, communication, working in teams, entrepreneurialism, global awareness, civic engagement, and problem solving” [27]. In short, learning how to use ICTs does not merely provide learners with ICT skills, but equips them with the building blocks of a modern skill-set and perspective.

3.3 E-learning Strategies

It is important to recognise that there are differences between e-learning environments and the traditional classroom environment; and that, with this, comes the need for new strategies for teaching. Churton is adamant that conventional teaching strategies “will not be successful” in e-learning [3]. He stresses the importance of both “educational and instructional strategies” [3]. Essentially, he argues for the importance of the strategy employed in incorporating e-learning into teaching, as well as the strategy actually used during e-learning [3]. It is not necessarily the content itself that needs to be adapted, but the way in which it is presented [3]. Teachers need to adapt their teaching methods in order to be able to effectively monitor the learners in their class. In an e-learning classroom environment, teachers do not always have the usual “visual cues” that inform them that learners are confused, so it is important to find ways of incorporating measurement of the learner progress in e-learning strategies [3]. Another

important pedagogical consideration is how to make learners' transition to e-learning as smooth as possible. It is important that students feel comfortable when being introduced to computers and e-learning so that they are not discouraged [3]. To achieve this, e-learning should be aimed at the "needs of the students", and should fit in with their "preferred learning styles" [3]. It may also be useful to provide mechanisms for learners to use to communicate with their teacher and one another using computer networks, so that they can ask for help and learn from each other [3]. If this is done correctly, learners will feel motivated to use e-learning, and explore its possibilities [3].

4 Online Learning Environments

An online learning environment is a completely web based "co-ordinated collection of learning materials" and activities [17, 28]. Essentially online learning environments act as a platform where integrated asynchronous e-learning can take place. This section aims to provide some synthesis of the literature on what facilitates the development of successful online learning environments. This is achieved by exploring different design considerations, investigating ways in which online content design can improve learner engagement, and outlining some approaches to the evaluation of online learning environments.

4.1 Design Considerations

Holmes and Gardner define instructional design as "a branch of knowledge concerned with research and theory about learning and teaching strategies, particularly in an e-learning environment" [13]. It is important that research into online learning environments is informed by at least a broad understanding of the major e-learning theories, the specific learning theories which are most relevant, and the design features that fit into those theories.

4.1.1 Learning Theories

As Churton argues, it is essential that the design of e-learning software is informed by learning theory [3]. It is thus important to include a survey of different learning theories used in e-learning. There are many different accounts of how learning works and how it should be approached. Before giving an overview of some of the major learning theories, it would be beneficial to convey a disclaimer from Terry Mayes. He stresses the importance to recognise that different learning theories are not disjoint ways of looking at the same learning, but compatible ways of looking at different learning activities within their particular contexts [7]. The different theories are not necessarily exclusive, but rather differ in the areas in which they place emphasis [7]. Dyke, Conole, Ravenscroft and de Freitas [7] identify a list of the major e-learning theories. Table 2 provides a brief explanation of the principle tenets of some of these theories. This list

is not exhaustive, but provides an idea of the major schools of thought on ways to approach e-learning.

4.1.2 Constructivist Design

Within the context of previously disadvantaged schools, where many teachers do not have extensive experience in the use of ICTs [14], an online learning environment would need to facilitate and support a learner-centred approach. Of the theories outlined in Table 2, the constructivist theories bear most relevance to this context, as they focus on “learner-centred and activity-oriented cognitive processes” for the creation of knowledge [7], which Dyke *et al.* contends are all “typical features of the constructivist paradigm” [7]. Coomey and Stephen support this conclusion by arguing that constructivist features such as a task-based focus and learner-centred conduct are required in contexts where “tasks and ... learning goals are specified *but* learners have control over how they work” [5]. Because of its focus on the role of collaboration in knowledge creation, constructivist theories also fit well with emerging Web 2.0 technologies, such as “blogs, wikis and ... social networking sites like MySpace ... and Facebook” [20].

The central premise from which constructivism follows is that “students create their own knowledge from their experiences and from interaction with their environment and other people” [13]. According to the pioneering constructivist psychologist, Piaget, children learn by incorporating unexpected responses and new information into their existing understanding [7]. In constructivist learning, the individualised construction of knowledge is encouraged over rote learning [13]. As can be seen in Table 2, constructivist learning theory consists of two separate complementary sub-theories: cognitive constructivism and social constructivism [7]. This is because construction takes place both in individual and social contexts; with new information not just being assimilated individually, but also challenged, contextualised and enforced through social interaction and exposure to the views of others [13]. Collaboration is encouraged in constructivist learning, as it provides exposure to different interpretations and articulations of the same information - which helps the learner to better understand their own views [13].

4.1.3 Design Features of Online Learning Environments

In their review of 100 journal articles and research reports from the field of online learning environments, Coomey and Stephenson identify certain categories of design features that were considered as necessary to successful online learning by most of the research reviewed [5]. In this paper they coined the “DISC” framework, consisting of four such features, within which most considerations in the design of online learning environments can be categorised [5]. The four design features they identify are: Dialogue, Involvement, Support and Control [5]. Exploring online learning design considerations under these headings will result in a comprehensive

Learning Theory	Focus
Behaviourist	Learning through <i>modification of behaviour</i> using stimuli. Based on the theories of behavioural psychologists like Skinner, these theories view behavioural modification as the outcome of learning. They emphasise the use of positive and negative reinforcement and association to bring about learning [7].
Cognitive	Learning through <i>reflective incorporation</i> of new information into existing knowledge structures. This theory emphasises instructional design around the learner's cognitive processing and existing knowledge structures [7].
Cognitive Constructivism	Learning through enquiry-led <i>active individual engagement</i> in a learning environment. Cognitive Constructivists see knowledge as learner-constructed, and so emphasises the importance of tasks that allow learners to approach them in their own way - which aids them in the discovery of new information through exploration [7].
Social Constructivism	Learning through cementing individual knowledge by <i>communicating</i> knowledge to others and understanding it in relation to <i>communal knowledge</i> . This school of thought emphasises the importance of learners' collaboration with each other and with experts. It sees communication as a vital learning process that helps learners clarify and contextualise what they have learnt and identify possible gaps in their understanding [7].
Experiential	Learning through <i>applying</i> information in solving problems and examining case studies. Experiential theorists believe experience to be the best way of establishing new information. They emphasise the use of real world problems, that relate to the learners' experience to allow them to learn new information by applying it [7].
Activity-based	Learning through mediating between the learner's "developmental stage" in an <i>activity</i> and that of society at large. These theories are based on the work of Vygotsky and originate from the idea that the context of an activity determines how learners interpret the results of that activity [7].

Table 2: Outline of major learning theories

overview of the different components and approaches that may be included in the design of online learning environments.

Dialogue According to constructivist learning theories, collaboration plays a central role in knowledge creation [13]. Vygotsky argues that learners “develop critical reasoning skills through internalising the process and content of dialogical argumentation” [7]. Including components that facilitate and encourage learners to discuss their learning with others will ensure that they achieve an understanding that is mediated by, and clarified through, the understanding of others [5, 13]. Some examples of components that may help achieve this include “e-mail, bulletin boards, ‘real-time’ chat, asynchronous chat [and] group discussion” [5]. Coomey and Stephenson argue, however, that getting learners involved in such discussion can be difficult, and so the use of collaboration components needs to be “carefully structured” into the learning environment (both online and in the classroom) [5]. They suggest that it may be useful to set discussion topics and time allocations for discussions; and even to have moderators in discussion groups that guide the discussion [5]. They also suggest that asynchronous discussion tools, such as forums, allow “active participation”, as well as time “for in-depth reflection and thoughtful responses” [5].

Involvement Involvement centres on “active engagement with material” [5]. Chan and Repman coin the useful term “flow”, to refer to “a state of total absorption by the student in online learning activities” [5]. In order to achieve “flow”, the learning environment needs to give control over content exploration to the learner, and should actively challenge the learner [5]. It also needs to hold the learner’s attention, specifically by providing “clear feedback” to the learner as they interact with the system [5]. Dyke *et al.* emphasises the importance of “activity” and “interaction” to learning [7]. Holmes and Gardner argue that learner involvement can be supported by requiring “creative responses” from the learner and through “tasks requiring the searching for and analysing of information” [13]. He also stresses the importance of dialogue as a part of keeping learners engaged with material [13]. Holmes and Gardner contend that constructivist learning models will only really work if learners see themselves as “producers” of information, rather than mere “consumers” [13]. Web 2.0 technologies like blogs may be useful in facilitating this paradigm shift [20]. Links to multimedia can also raise learners’ interest levels and facilitate involvement through more exciting media than plain text [25].

Support Perhaps the most difficult feature of an online learning environment is support [5]. Support refers to mechanisms that guide learners’ interaction with content, and helps them when they get stuck [5]. Learners are often frustrated by a lack of support online, particularly if they are accustomed to a traditional classroom environment [5]. To prevent this, it may be advisable to maintain “periodic face-to-face contact” in addition to online supervision [5].

It is also essential that learners' queries via email and other online support mechanisms are responded to timeously, so that they do not feel like their learning is without support [5]. The same holds for feedback on assessment and group discussions, as assessment offers guidance to the learners on which learning areas require attention [5]. Possible online support mechanisms include email, discussion groups and links to external experts [25]. In situations where there is a lack of teacher support, it may also be useful to encourage learners to form online "working groups" [5]. This will make learners feel like part of a learning community, and ensure that they have somewhere to go with their queries, even before seeking help from teachers [5].

Control The primary factor that differentiates e-learning from conventional teaching, is that it offers the opportunity for learning to be learner-managed [5]. Stephenson argues that e-learning is causing a shift in pedagogy "towards giving learners greater responsibility for managing their own learning" [25]. Coomey and Stephenson define control as the "extent to which learners have control of key learning activities and the extent to which they are encouraged to exercise that control" [5]. This control includes how long learners take to complete tasks, which tasks they complete and in which order, what material to study and which sources to use [5]. Holmes and Gardner argue that control over content encourages responsibility, exploration and curiosity [13]. Learners often have difficulty exercising this control over directing their own learning, however, particularly if they see the online learning environment as a different instantiation of traditional classroom learning [25]. They feel that learning requires direct teaching, and become unsettled when the teaching component of learning is not as obvious as in classroom learning [5]. To overcome these feelings, it is important that teachers act as coaches, who guide learners through this new way of learning and help them feel comfortable using it [5]. This is of particular importance in the case of learners with limited ICT experience, where learners may have difficulty with the exploratory nature of e-learning and deciding how to direct their own learning [5]. It is also important that learners' control over their learning is structured in such a way that it takes their other activities into account - otherwise some learners may not know when to stop their exploration and spend too much of their time on a particular task or concept [5]. The inclusion of a course structure, and perhaps structuring online content accordingly, will help guide learner activities [5]. Stephenson makes the important observation that the amount of control learners have exists on a continuum with the amount of control teachers have; and thus the extent to which e-learning is learner-managed depends on how online learning environment designers "choose to manage (or constrain) the potential" of the available technologies [25].

4.2 Learner Engagement

Modern learning theories promote "learning as transforming knowledge" over "learning as reproducing knowledge" [1]. Cairncross and Mannion argue that this "deep learning" requires "active involvement on the part of [the] learner" in order to be effective [1]. By virtue of the

fact that e-learning is so learner-centred, it requires a significant level of learner responsibility in order to work effectively [3]. It is therefore essential that learners are sufficiently motivated to take responsibility for their learning [3]. According to Churton, Jafari argues that “sites such as MySpace, You-tube, and e-bay are ‘sticky’ ” and manage to “lure individuals back to the site on a repeated basis” [3]. Churton contends that it is necessary to create a similar level of engagement in online learning environments in order to motivate learners to use them repeatedly [3]. Johnson and Aragon argue that online learning environments “must be able to gain and maintain students’ attention by providing an environment that is interactive and participative” [16]. This section deals with different ways of encouraging learner engagement in an online learning environment.

4.2.1 Multimedia

Cook, White, Sharples, Sclater, and Davis define multimedia as “the orchestrated combination of text, graphic art, sound, animation and video elements” [4]. Johnson and Aragon argue that what they call “The MTV Generation” prefers visual content over traditional learning materials [16]. They assert that there is “no excuse for not incorporating multimedia into technology-based learning systems” [16]. According to Waterhouse, the use of “multimedia resources in e-learning can dramatically improve student responses” to content [28]. She argues that multimedia, including images, animations, videos and audio clips will help learners to understand information by appealing to their dominant senses [28]. Johnson and Aragon found that that graphic images, photographs, and videos enhance student motivation [16]. Incorporating multimedia can “increase enjoyment” and learner engagement [1]. At the very least, multimedia can act as a means to “motivate a learner into using” an online learning environment and so initiate engagement with other material [1].

It is important that the multimedia design of an online learning environment takes individual preferences into account [1]. Some learners learn better when they are able to approach content holistically - they begin by learning broad concepts and then learn the detail by fitting it into those broad concepts [1]. Other learners prefer the more conventional method of simply moving through material sequentially and building up a broad overview once they have covered the material [1]. Both of these approaches can be catered for by giving the learner more control over their learning, by allowing them to navigate freely between sections of multimedia content [1]. This can also be achieved using a “hierarchical-based menu system” where learners can either follow the set order or an alternative order that better suits their learning needs and preferences [1]. Cairncross and Mannion make a distinction between learners who require assistance in structuring their approach to content and learners who prefer to control their own learning structure and navigation [1]. Content therefore needs to be structured clearly enough to orientate learners who need structure, as well as flexible enough for learners who want to exercise more control [1]. Multimedia can be used to present the same information in different

ways, thereby providing learners the opportunity to engage with material in the way they find most useful and comfortable [1, 28]. This duplication also aids in the transfer of information “from short-term memory to long term memory” [1].

Cairncross and Mannion point out the importance of taking human cognitive limitations into account when using multimedia, in order to prevent “divided attention and disorientation” [1]. It is salient to keep in mind that some types of multimedia content (and combinations of these) are better suited to certain types of content [1]. The inclusion of multimedia content does have the potential to distract from other learning materials [1]. Cairncross and Mannion argue that simply providing repositories of links to multimedia content is not effective, as learners become overwhelmed and unproductive [1]. Instead, multimedia should be closely linked with other learning materials, perhaps using a “narrative-like structure” [1]. The use of hyperlinks can enrich the learning experience, though, if they are structured in such a way that they link from positions in content with similar themes [1, 4].

In addition to the ability to navigate through media in a way that suits learners, it is essential that they are able to engage in interactive activities with learning material [1]. The use of animations can allow learners to engage with simulations of real world scenarios and explore “alternative courses of action”, without being inhibited by the fear of incorrect actions [1]. Multimedia also allows for role-playing, which offers another useful way for learners to test out new knowledge in realistic scenarios [1]. An essential consideration when designing interactive learning activities is to ensure that they “cognitively engage the learner” and “cause them to think about the material that is presented” and how it applies to real world scenarios [1].

4.2.2 Assessment

Before undertaking any discussion of assessment, it is important to make the distinction between summative and formative assessment. Summative assessment refers to assessment, usually in the form of examinations, that determines whether a learner has achieved the required outcomes for a course or qualification [24]. Formative assessment, on the other hand, which is what this discussion focuses on, refers to assessment that is used to evaluate learner progress, provide feedback to learners and assist them in achieving learning outcomes [24].

A major benefit that the web has for education is the ability to integrate assessment with learning material [24]. Through designing an online learning environment that provides “automated feedback” to the learner, while they are learning, it is possible to create a much more engaging and interactive way of learning [24]. If this feedback is “based on the input of the learner”, it enables them to incorporate it into their current understanding and get a sense of how well they understand the content [24]. Hartog, Draaijer and Hofstee call this type of content “activating learning material” and argue that it “forces the student to actively engage with the learning material by making selections and decisions” [12]. Instant feedback on learner responses to

content is an effective way of encouraging learners to learn from their mistakes, as the feedback is received before any misunderstandings can be internalised [28]. Behaviourist theories of learning state that providing feedback indicating that a learner has understood a section can act as a form of extrinsic motivation [13]. Automated feedback can therefore help boost learners' confidence as they progress, by confirming their understanding of the content [24].

There are several limitations to electronic assessment, mainly due to the limits to what computers are able to mark [24]. Some teachers consider electronic assessment to be "inappropriate for assessing ... 'higher order' learning outcomes" [24]. These limitations should not discourage the use of electronic assessment, however, as it can still be a useful way of administering simple assessment of learners' progress for self-assessment [28]. By closely linking questions to the points in the learning material where they appear, it will be possible to provide learners with a useful sense of their progress while they work through material [28]. In addition, there are techniques that try to improve the efficacy of the standard multiple choice questions normally used in electronic assessment [24]. These include negative marking and asking learners to specify how confident they are of their responses [24]. It is possible to mark electronically the use of one word or short phrase questions [24]. It is even possible, using "natural language processing techniques" to mark sentence-length responses [24]. Hartog, van Boxel, Hofstee, Latour, Ritveld, Verstralen and Gorissen include "drag-and-drop", "fill-in-the-blank" and "hot spot" in the list of computer-assessable question types [12]. Administering assessment using computers has the added benefit of being able to perform useful analysis of learner results easily - thereby providing both learners and teachers with a meaningful indication of both individual and class performance [24]. Electronic assessment also "offers consistency in marking", which is useful for performing comparative analysis [24].

4.2.3 Online Discussion

One of the major trends that characterises Web 2.0 is the shift from seeing the Internet as "read-only" to seeing it as "read/write" [2]. The web is no longer just a way of getting information; it is now also a way for individuals to share information with others [2]. By incorporating this information-sharing culture and technology in online learning environments, it is possible to turn learning into a more collaborative process and encourage learners to share information with one another [2]. Waterhouse contends that enabling this kind of communication in an online learning environment has several advantages [28].

First of all, online discussions make it easier for learners to communicate [28]. Online communication provides learners with a method of communication that is instantly available and easily accessible from the content that they wish to discuss [28]. Online communication is convenient [28]. As a result of discussions taking place online, learners can take part from wherever they happen to be [28]. The absence of geographical constraints means that learners can exchange ideas with other, geographically distant learners that they would ordinarily not be able to contact

[5, 28]. The asynchronous nature of online communication media such as forums and email, means that learners are also able to contribute to discussions at any time [28]. Online communication also has the benefit of removing the anxiety experienced by some learners in traditional face-to-face discussions [28]. Shy students will often be more inclined to participate in online discussion, largely due to the fact that asynchronous discussion offers them the opportunity to reflect on ideas in their own time, and edit their responses before posting them [28]. Despite the benefits of asynchronous online communication, synchronous communication is still a useful way of exchanging ideas - and this can be facilitated through online chat [28].

Secondly, electronic discussion makes it easier for learners to think about ideas [28]. Dyke *et al.* argue that reflecting on, and thinking about, what has been learnt is central to the learning process [7]. The asynchronous nature of forums allow learners to take time to reflect on what others have said before replying [7, 28]. Waterhouse argues that this leads to “more thoughtful responses” [28]. She also argues that electronic discussions encourage learners to take pride in what they say, due to the fact that it will appear in writing for their peers to see [28]. In addition, online discussions tend to be more “detailed and involved” because of the nature of written communication and the fact that they are not constrained to scheduled time in class [28].

Thirdly, electronic discussion fosters a sense of a learning community [28]. An interesting feature of online communication is that physical characteristics such as “gender, age, race, and disability” are largely obscured; creating an environment that is safer from discrimination on these grounds [28]. Waterhouse contends that learners who communicate online “build a sense of community” and find it easier to communicate their ideas within such an online learning community [28]. Learners also gain valuable interaction skills, particularly relating to the respectful exchange of ideas [28]. Graham, Cagiltay, Lim, Craner and Duffy argue that online discussion allows learners to “challenge the ideas of the instructor, of other students, or those presented in the readings or other course materials,” which enriches their own understanding of concepts [9].

A final benefit of electronic discussion is that it is automatically recorded. Quite simply, this creates a knowledge base for future learners [28]. Because forums are archived, electronic discussion results in an easily accessible record of a wealth of opinions, thoughts and ideas around a variety of discussion topics [28]. Learners can use these forums to see what others have thought and use this insight to guide their own learning [28]. Recorded discussions also enable teachers, tutors and course administrators to monitor what learners are learning and how well they are engaging with the content [28].

Blogs are another method of electronic communication, which are focused on the sharing aspect of Web 2.0 [2]. A blog, or web-log, as defined by Carliner and Shank, is “a series of chronologically arranged (most recent at the top) online journal entries that is frequently updated by its author” [2]. Dyke *et al.* identify “thinking and reflection” as “core elements of learning” [7]. Johnson and Aragon argue that an online journal can “promote continuous reflection through-

out the course” [16]. By teaching learners to blog, it not only encourages them to take more ownership of the ideas they are learning about, but also facilitates “idea sharing and interaction” with their peers [18, 20]. Lin, Yueh, Liu, Murakami, Kakusho and Minoh found that blogging elicits “personal authority ” in learners over what they say and provides a good representation of learners’ progress [18].

4.2.4 Activity Based Learning

Dyke *et al.* identify learning “from experience and activity” as one of the “three core elements of learning” [7]. Johnson and Aragon argue that “project-based learning and cooperative learning are common techniques for engaging students in activities that involve considerable amounts of creativity, decision-making, and problem solving” [16]. Activity theory places emphasis on the idea that humans learn based on their interactions [7]. A well designed online learning environment will facilitate interaction that stimulates “decision-making, problem-solving and hypothesis-testing” [13]. Activity based learning focuses on learners cementing their understanding of ideas by applying their understanding in activities such as simulations and case studies that mirror real world scenarios [7, 16]. According to Cairncross and Mannion, “understanding occurs best through performing tasks” where “new knowledge” is applied [1]. Kolb’s learning cycle emphasises “learning by doing” and consists of four distinct stages: “experience, reflection, abstraction and experimentation,” with activities playing a large role in the experimentation stage [7]. Holmes and Gardner present “problem-based learning”, “online simulations and gaming” and “WebQuests” as activities that facilitate the conceptualisation of newly acquired information [13]. In problem-based learning, learners are required to practise analytical and creative thinking to come up with solutions to real world problems or dilemmas [13]. Online simulations are useful in the way that they model real-life scenarios for learners to interact with [13]. Although games are often not as realistic, they are useful in increasing learner motivation as they tend to be fun and competitive [13]. WebQuests involve assigning learners a topic to research on the Internet and aim to aid the development of critical reading, analysis and synthesis skills [13].

4.2.5 User Interface

Nam and Smith-Jackson argue that the success of an online learning environment is dependent on whether it “effectively facilitate[s] learner interactions” [21]. User interface design is particularly important in the field of education because a more intuitive user interface will allow learners to focus quickly and easily on learning material, rather than spending time learning how to use the web site [21]. Nam and Smith-Jackson also stress the importance of taking the needs of learners into account throughout the user interface design process, in order to ensure that the user interface facilitates a learner-centred approach [21]. Hamid argues that good user

interface design is crucial because it gives the learner “a sense of control” [11]. Graham *et al.* provide a framework for evaluating user interface design, which is outlined in Table 3 [9]. As discussed by Hamid, Nielsen identifies five traits of effective user interface design, which will be useful to keep in mind while exploring Graham *et al.*'s framework:

- ease of learning
- efficiency of use
- memorability
- error frequency
- user satisfaction [11]

4.3 Evaluating Online Learning Environments

In addition to considering the design of online learning environments, it is also salient to investigate ways of evaluating their success. Oliver, Harvey, Conole and Jones argue that evaluation can “contribute to research” and provide “feedback for a changing teaching and learning practice” [22]. Oliver, Harvey, Conole and Jones suggest an “input/output efficiency” based evaluation approach [22]. Table 4 provides an overview of some of the major evaluation techniques discussed by Oliver *et al.*

Principle	Description
Consistency of web page layout and design	<ul style="list-style-type: none"> ● Improves the learnability of the environment ● Makes it easier to access information in the environment ● Allows the use of knowledge gained in one area of the environment to be transferred to another [9]
Clear organization and presentation of information	<ul style="list-style-type: none"> ● Complicated or busy interfaces prevent learners from achieving the tasks they set out to complete ● Organising information into clear categories makes information more meaningful and makes navigation more efficient ● Avoid presenting too much information to the learner at one time in order to prevent cognitive overload and confusion [9]
Consistent and easy-to-use web site navigation	<ul style="list-style-type: none"> ● Make sure learners always know where they are within the structure of the environment ● The use of “standard navigational bars, icons, and links ... on each page” allows users to recover quickly from navigational errors ● The use of hyperlinks can improve the efficiency of access to information ● The use of consistent navigational tools improves the memorability of the environment [9]
Aesthetically pleasing design and graphics	<ul style="list-style-type: none"> ● Poor aesthetic design hinders learner engagement ● Graphics “should be kept simple” and relevant so that they do not distract or confuse the learner ● The user interface should be designed so that learners are able to comfortably engage with it for extended periods of time [9]

Table 3: Graham *et al.*'s user interface evaluation framework.

Evaluation technique	Description
Experimental methods	Experimental evaluation follows the model of a traditional experiment. In order to test a hypothesis, a controlled environment is set up and the effect of a few variables on that environment is monitored. The outcome of the experiment is evaluated using quantitative measures such as data collection and statistics. Experimental evaluation often aims to measure improvements or differences between scenarios [22].
Illuminative evaluation	Illuminative evaluation places great importance on the contexts that influence what is being evaluated and takes a “more open-ended, exploratory approach to evaluation”. Researchers try to remain as impartial as possible and consider all possibilities that surface during the evaluation equally [22].
Systems approaches	Systems approaches are directly “linked to learning outcomes”. Rather than evaluating the process of learning, these approaches focus on whether certain predetermined expected results are met [22].
Action research	Action research focuses on evaluation as a collaborative process between researchers and research subjects. It places great importance on the interests of research subjects and is often redirected to pursue these interests. Action research is therefore subjective in nature and tends to focus more on facilitating change than just evaluating performance [22].
Responsive evaluation approach	The responsive approach aims to monitor the current situation and take practical steps, informed by the thoughts of research subjects, to bring about changes in the situation. There is a focus on producing research that will be considered useful by research subjects [22].

Table 4: Outline of major approaches to evaluation.

Waterhouse discusses two types of feedback that can be used to evaluate online learning environments: Student Feedback and Peer Evaluation [28]. Student Feedback can be obtained using anonymous student surveys, which can be administered online [28]. Such surveys aim to determine whether the learners found the course valuable, whether they felt that their individual needs were met, whether they felt the course was interactive enough and whether the course was appropriately administered [28]. They can also be used to evaluate the infrastructure of the web site; including whether particular components were effective and easy to use, whether the site was well structured and whether content was relevant and up to date [28]. Anonymous student surveys contain some questions that need to be answered with a rating from one to five, ranging from “strongly disagree” to “strongly agree” [28]. Web-based applications are also able to “systematically collect continuous feedback from users” in the form of usage statistics, which provides course administrators with easily accessible details on learner performance [21]. Peer Evaluation involves formal or informal reviews by colleagues from within the organisation or

colleagues from other organisations in the field [28].

5 Conclusion

This chapter has provided a survey of the literature in the field of e-learning. Through an exploration of the literature that deals with the state of ICT use for education in South Africa, it has become apparent that there are many constraints and obstacles that need to be kept in mind when developing an online learning environment for use in South Africa. Fortunately, the literature also points to an increase in support for ICT use in education and highlights several initiatives driven by the South African government to facilitate the implementation of e-learning in schools. By reviewing the literature surrounding e-learning, the concept has been broadly defined and briefly justified as a beneficial approach to learning. The need for innovative teaching approaches for the effective implementation of e-learning has also been outlined. The discussion narrowed in focus to explore literature that suggests approaches for the effective design, pedagogy and implementation of online learning environments. This included an outline of major e-learning theories and the presentation of a framework aimed at categorising design features required in online learning environments. The discussion also included an investigation into design and implementation techniques that can be used to improve learner engagement when using online learning environments. Lastly, this chapter outlined literature suggesting approaches and techniques for the evaluation of online learning environments.

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