International Journal of Economic Research
Volume 15, Number 1, 2018, ISSN : 0972-9380
available at http: www.serialsjournals.com

THEORY AND PRACTICE FOR DEVELOPING A TECHNOLOGY-DRIVEN LEARNING ECOSYSTEM FOR DISTANCE EDUCATION LEARNERS IN SOUTH AFRICA

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Abstract: Distance education is characterised by a lack of interaction between learner and facilitator, urging distance education institutions to develop effective systems to optimise learner success. FutureLearn, the largest distance education provider in South Africa for learners in the schooling phase, is in the process of developing such a system. The development of such a comprehensive learning system does not merely entail the development of technology-driven tools, but designing a system that would enable learning, irrespective of the lack of face-to-face interaction. Consequently, this paper intends to suggest a framework for the development of a technology-driven learning system for distance education learners.

Using FutureLearn as a case study, the researchers reflect on both the theoretical and practical concerns when a learning system as described above is being designed; 'theoretical' in terms of the basic learning theories and curriculum requirements, infused by data on the specific needs of FutureLearn's learners, and 'practical' in terms of the implications that the theory and data hold for the development of a learning system. The availability of such a framework can contribute to the enhancement of learning in the distance education sector, as well as the integration of technology-driven systems in South Africa.

Key words: distance education, learning, technology-driven system, exploratory case study, learning theory and practice.

INTRODUCTION

The development of a technology-driven learning ecosystem for distance education learners aims to guide learners toward effective learning, particularly since facilitators and learners are removed from one another. The separated positioning of these two entities poses a challenge to distance education institutions to develop effective systems that would address both the learners' needs and educational principles. According to Ally (2008:4), the development of such a learning system should be based on the "principles of learning and how students learn", and not merely the development of a technological system.

The viewpoints of Hassanzadeh, Kanaani and Elahi (2012), and the well-known debates of Clark and Kozma (Becker, 2010), reiterate that technology can merely serve as a platform and a vehicle for learning, but cannot make learners learn, which implies that the way in which learning is optimised should still be embedded in an educationally sound manner. The renowned distance educationalist, Terry Anderson (2008), emphasises the challenge for system developers to construct an educationally sound learning environment. In terms of the above context, this paper addresses the planning of the construction of a learning ecosystem, where a coherent platform is imperative for an integrated learning journey. The purpose of this paper is therefore to *propose a framework for the* *development of a technology-driven learning ecosystem for distance education learners in South Africa, considering both theoretical and practical concerns.*

In contextualising this paper, it is necessary to provide a brief overview of the status of the researchers, the institution used as case study, and the distance education sector in South Africa.

The researchers are part of the leadership team at FutureLearn, a distance education institution providing resources and support to approximately 20 000 registered learners in the schooling phase in the country. South Africa has a number of private distance education providers, of which FutureLearn is the largest.

The term 'distance education' for learners in the schooling phase primarily refers to learners in the post-compulsory phase. In South Africa, education is compulsory by law up to Grade 9 or up to the age of fifteen years, which constitutes the General Education and Training phase (GET). The GET phase precedes the Further Education and Training phase (FET) for Grades 10 to 12, which is not compulsory by law. GET phase learners who do not attend school are regarded as home-educated learners, while those in the post-compulsory FET phase, who are not in formal schools, must register with private distance education providers, and are consequently regarded as distance education learners. For the purpose of this paper, FutureLearn is used as the case to be investigated.

In South Africa, distance education at school level is not as developed as in some highly populous countries, such as Indonesia, Mexico, China, Pakistan or Brazil. South Africa's National Department of Basic Education does not cater for distance education as mode of delivery in the same way as the governments of the abovementioned countries do, implying that distance education is vested in the private sector (Niemann, 2017:90).

For the institution to live up to its reputation as provider of quality education, FutureLearn has not only embarked on the development of a technology-driven learning system, but is set on delivering an ecosystem that encompasses a variety of learning elements to be integrated in such a way that they create a valuable overall learning experience.

PROBLEM QUESTION AND OBJECTIVES

Technology-driven learning systems contribute to the flexible nature of distance education, as it "allows participants to collapse time and space" (Cole, 2000:34), however, the learning tools must be designed in a manner that would form an interrelated entity which promotes learning. Some years ago, Forsyth (1998:43) emphasised that learning technology must be "student-centred", meaning that it is relevant to learners' context and understanding – a principle that was later also emphasised by Rossett (2002:4), who stated that "it must be done right". Consequently, this paper intends to address the question: ***How should the development of a technology-driven learning ecosystem for distance education learners be approached to ensure that learning is promoted?***

In addressing this question, the paper will address the following objectives to unravel the underlying theories and their implications for practice:

- To provide an overview of distance education learners' learning support needs,
- To view educational theories underpinning effective learning, which should drive the development of a technology-driven system, and
- To suggest a framework for the development of a technology-driven ecosystem to answer to educational theories and to fulfil leaners' needs in everyday practice.

RESEARCH DESIGN

This paper reflects on an exploratory case study of the development of a technology-driven ecosystem for the distance education provider, FutureLearn, situated in the capital of South Africa. A case study approach has been applied, as it allows for a contextual analysis and the interrelation between the elements (Cooper & Schindler, 2014: 150) to explore how the institution is learning about the challenges they are facing. Such an exploratory study "is particularly useful when the researchers lack a clear idea of all the problems they will meet" during the process (p. 151).

In an exploratory fashion, FutureLearn began to develop a technology-driven learning system that will not only address the needs of their distance education learners, but also a learning system that addresses educational and learning requirements. In approaching those development challenges, the institution had to conduct a proper analysis of the requirements for such a system. This paper presents the theoretical learnings that lay the foundation for the development process, as well as the practical challenges facing the development of such an eco-system. At this point in time, the system is being developed according to the underpinning educational and learning theory. A number of functionalities on the platform has already been designed and is being piloted. Some of the more intricate design challenges must still be straightened out, but the researchers chose to reflect on the learnings and the framework depicting the theoretical and practical demands of the development of such a system.

THEORY DERIVED FROM THE LEARNING SUPPORT NEEDS OF DISTANCE EDUCATION LEARNERS

Previous research done by Niemann (2017) on the needs of distance education learners in South Africa indicated that their needs were largely embedded in their quest for a platform that would allow for the unlatching of content and for guided facilitation, as suggested by the Anderson's Interaction Equivalency Theorem (Anderson, 2003(a) & (b) and Anderson & Garrison, 1998).

Based on the accumulated data, the need for stimulating content and some guided facilitation emerged, confirming the need for two components depicted in Anderson's Theorem (Anderson, 2003(a) & (b) and Anderson & Garrison, 1998). Niemann (2017) extended the Interaction Equivalency Theorem to address the needs of distance education learners to transcend the lack of face-to-face tuition, as illustrated in figure 1.

In considering the data from the previous research, a number of elements that have bearing on a technology-driven **tutor/learning platform** are valuable for this paper, implying that when such a system is developed, it has to account for:

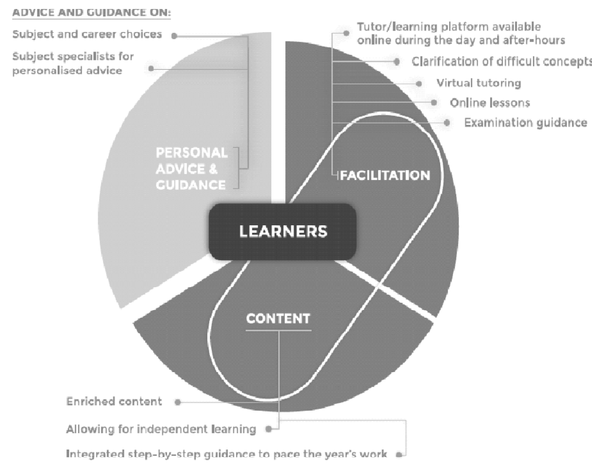

Figure 1: Adapted version of the Interaction Equivalency Theorem, illustrating distance education learners in the FET phase in South Africa and Niemann's model (2017)

- the optimisation of independent learning,
- the pacing of content mastery (step-by-step guidance),
- unlatching the content through various actions (such as the clarification of difficult concepts, virtual tutoring, online lessons, examination guidance), and
- accessibility and availability.

The first three abovementioned elements particularly have implications for the quality of the learning process, which will hence be viewed.

THEORIES OF LEARNING AND THEIR IMPLICATIONS FOR THE DEVELOPMENT OF A TECHNOLOGY-DRIVEN LEARNING SYSTEM

Learning and the working of the brain during the learning process are complex, rendering it impossible to include a detailed description within the limited scope of this paper. A concise explanation to enhance the understanding of the learning processes and theories are provided, as those requirements must be accounted for when a sound learning system is developed.

Theories of Learning

The major learning theories emerged from the behaviourists, the cognitive psychologists, and the constructivist thinkers. The behaviourists focused on the effect of *external stimuli* to initiate learning, emphasising the individual's innate curiosity to accumulate knowledge – factual information (the *what*) (Ally, 2008). The cognitive psychologists, on the other hand, were more concerned with principles and processes (the *how*) (Ally, 2008). They particularly emphasised the use of memory, thinking, motivation and reflection in the learning process. They stressed the use of elements that would stimulate learners' sensory awareness, and enhance their capacity to make sense of new information. (Piaget, 1964).

The cognitive theorists largely based their theory on the working of the human brain, which needs sensory stimuli to the short-term memory (working memory) to evoke the sense-making process. This is the process by which the learner interprets information according to his/her personal reality (Baddeley & Hitch, 1974), and as soon as the information makes sense, it is stored in the long-term memory (Baddeley & Hitch, 1974). Kalat (2002) believed that if the information in the working memory is not processed properly, it will not be stored in the long-term memory. The following figure depicts the renowned Working Memory Model of Baddeley and Hitch (1974).

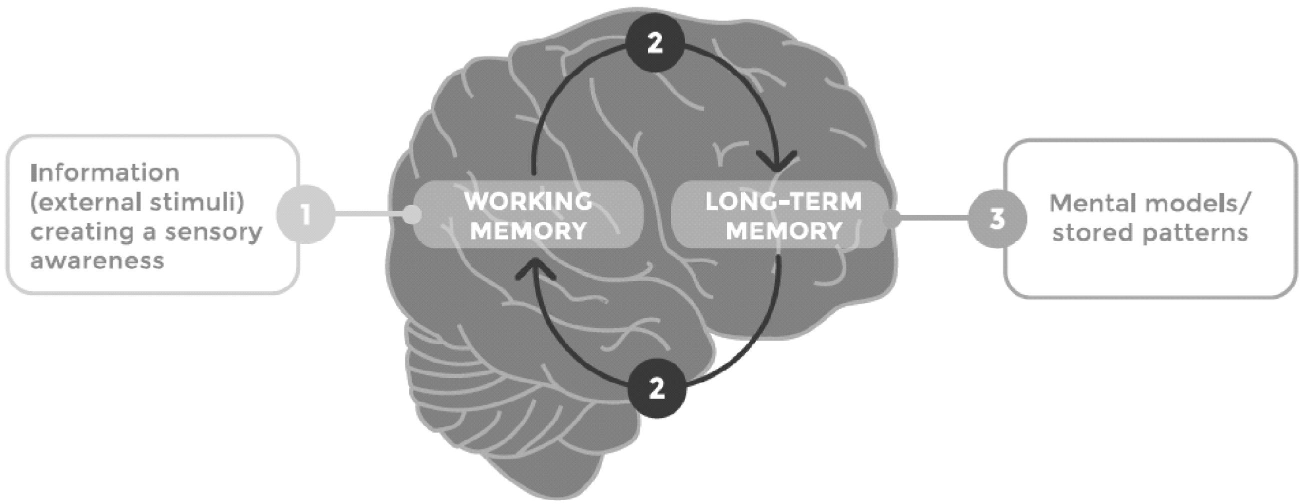

Figure 2: Working memory model (Baddeley & Hitch, 1974, adapted

Explanation of figure 2

1. The brain receives **new information** through **external stimuli** into the **working memory.**
2. The new information is **processed** by recognising **patterns**, recalling **stored information**, and **matching** the new and stored patterns through **meaningful connections**.
3. The new information is **integrated with mental models or stored patterns** by placing it in context and storing it in **long-term memory.** This new information is now retained, and can be recalled and applied through **updated mental patterns (demonstrating understanding and insight)**

The constructivist learning theorists largely extended the views of the cognitive psychologists by recognising the need for higher order thinking, meaning-making and contextual learning (the *why*). This implies that learning consists of both constructing meaning, and of constructing systems of meaning, and not learning isolated facts and theories in an abstract manner that is removed from real life. These concepts were initially embedded in the theory of Dewey (1938), but were only recognised much later. In his later work, Piaget (1974) joined the constructivist school of thought, referring to learners' ability to apply what they have learnt, and to reflect on their learning. They emphasised that learners must become the centre of the learning process by being led to construct their own knowledge (Ally, 2008) – a movement from *'instruction'* to '*construction*', whereby learning becomes an active process. In this context, the theories of Lev Vygotsky (1978) plays a significant role, particularly his well-known *Zone of Proximal Development,* which implied that learners should be provided with experiences that would encourage them to learn by themselves.

Some years later, the transformational approach of the experiential learning cycle of David Kolb (1981) and Engeström's Expansive Learning Theory (Engeström, 2001 & 2004), contributed to the debate on modern learning theories, although their work were largely based on the basic learning theories. The work of Lev Vygotsky (1978), the Kolbs' (1981 & 2005), Engeström (2000), and Niemann (2013), highlighted the value of the learner's concrete experience by scaffolding upon existing knowledge and understanding. Engeström (2000: 960) agreed that most learning concepts draw on the basic psychological notions of mental processes. According to Engeström (2001:139 & 2004: 14), expansive learning occurs when new knowledge and practices are emerging and the new knowledge is internalised. He used the apt concept of 'co-configuration', which refers to the construction of new knowledge as tying together loosely interconnected systems as a co-configuration of parts. He also refers to this connection as "knot-working", implying the tying, untying and retying of seemingly separate threads of knowledge and practice in order to generate new insights and understanding (2001:139). Siemens (2013) also emphasised the importance of stimulating learning in such a way that meaningful connections in the brain are being made in order to deepen understanding and to optimise memory.

In viewing the various learning theorists' lines of thought, there are significant overlaps between the theories. In the following section, a learning taxonomy is presented in an attempt to illustrate the learning process and to indicate what must be put in place to ensure effective learning.

Learning Taxonomy

For the purpose of this paper, it was necessary to develop a learning taxonomy in order to provide a foundation for the development of a technology-driven learning system. In developing such a taxonomy, this paper provided a reflection on the needs of distance education learners, as well as the basic learning theories. However, it was also necessary to view the learning and content requirements as stipulated by the Curriculum and Assessment Policy Statement (CAPS), South Africa's national curriculum for FET learners.

The CAPS (RSA, 2011 & 2016) requires learners in the FET phase to be

- directed by the learning aims/objectives,
- stimulated to develop critical thinking skills,
- able to identify and solve problems,
- exposed to strategic questions to stimulate creative thinking,
- enabled to collect, analyse, organise and critically evaluate information,
- provided access to a variety of sources (such as videos and newspapers),
- able to apply essential knowledge,
- enabled to develop essential skills,
- guided through the topics to be mastered within a particular timeframe,
- assessed through a variety of forms of assessment
- assessed both formally and informally in order to determine whether the learning aims have been achieved,
- provided with feedback, and
- enabled to synthesise and evaluate.

By synthesising the curriculum requirements and the learning theories from the various schools of thought, it became possible to develop a learning taxonomy as explained in figure 2.

The Practice of Learning System Development

Against the background of the learning taxonomy in figure 2, FutureLearn has been challenged to figure out how these theoretical learning principles can be transferred into practice. George Siemens (2013) indicated that technology and the dawn of the digital age had a major influence on learning theory. He holds the view that connectivity with others and the internet has

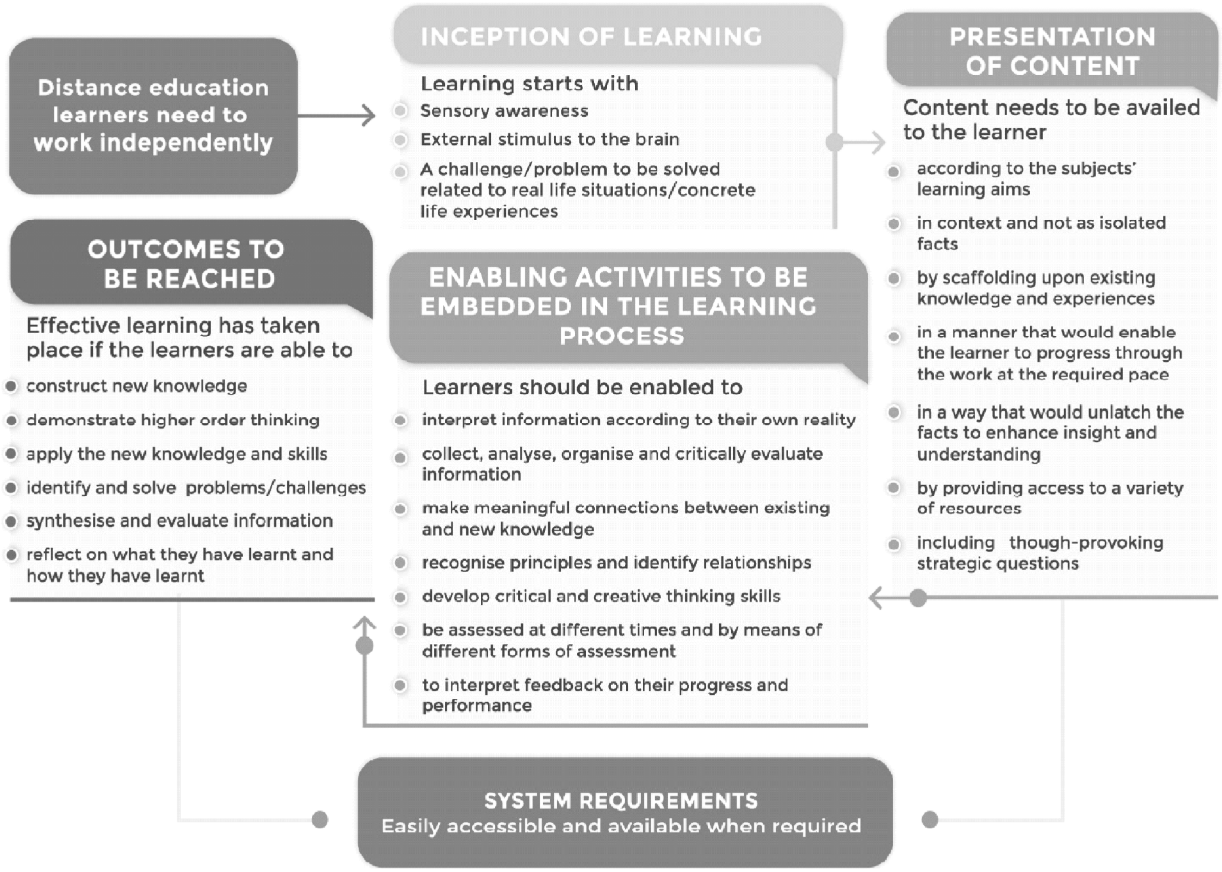

Figure 3: Learning taxonomy

implications for the knowledge and experiences that learners are accumulating. Stephenson (2004, n.p.) stated that experiences are no longer embedded only in the learners themselves, as they do not need to "experience everything, because other people's experiences become the surrogate for their knowledge". By being connected, others' knowledge and experiences also become everyone's knowledge and experiences. Digital learning is therefore no longer restricted to the individual, but "manipulated" and "opened up" by technology (p. 3).

Hence, FutureLearn's way of thinking in the development of a learning system will be based on the learning taxonomy in figure 2, and constructed as a framework (presented in table 1). The first two columns indicate the theory that underlies the development of a learning system, while column three indicates the functionalities that FutureLearn's developers are incorporating into the system.

The framework presented in table 1 reflects the contextual analysis conducted by FutureLearn, the direction of the planning for the learning system development, and the interrelation between the various elements that informed the plan. The framework uses the key theoretical elements of the learning taxonomy as point of departure – the inception of the learning, the presentation of the content, the required enabling skills, and the determination whether the outcomes have been reached. The system requirements are indicated in the third column of Table 1 as a demonstration of practical functionalities needed for developing a technology-driven learning ecosystem to enhance the learning success of distance education learners.

True to the nature of exploratory research, the researchers used this paper to report on their journey and thus venture into public space, expecting inputs and learning from the experiences of others – hence what the presentation of this paper hopes to achieve.

Table 1
Framework for a Technology-driven Learning System: Theory and Practice

Learning Taxonomy Phases	*The Taxonomy's Learning & Educational Requirements*	*Functionalities To Be Builtinto The Learning System*
Inception of learning	**Learning starts with** • a sensory awareness, • a challenge/problem to be solved that relates to real-life situations / concrete life experiences, and • an external stimulus to the brain to enhance learning.	• Gaining access to the system is intuitive and fast. • The learner's main email address is linked to a single sign-on. • The guardian's email address is used as a security back-up. • The learner's profile is populated from the administration system, and additional fields can be added to amend the learner's profile. • Specific roles are allocated to learners, parents and tutors. • The software interface for different learning phases differ. • The layout is consistent, enabling users to get used to the design and to know where the various functionalities can be accessed. Consistency builds confidence in the system and its functionality. • The design resonates with users. In this regard, gamification frameworks are used, such as: o avatar characters, o point-scoring/progress-tracking, o goals/levels/achievements, o awards for achievements, and o ranked public leadership boards.
Presentation of content (WHAT?)	**Content should be availed to the learner** • according to the subjects' learning aims, • in context, not as isolated facts, but scaffolded upon existing knowledge and experiences, • in a way that would unlatch the facts to enhance insight and understanding, by providing access to a variety of resources • including thought-provoking strategic questions • in a manner that would enable the learner to progress through the work at the required pace.	• The outcomes/aims are clearly defined by the topic (defined by the national curriculum statement). • The required content on the e-book platform is easily accessible. • The content is presented by means of lessons, accompanied by clarifications, illustrations and visual presentations to unlatch the facts. • Characters/real life presenters are used to develop and present lessons. • Subject content needs to be availed in a variety of formats to ensure that learners are stimulated at different levels and according to their needs and preferences, such as hardcopy books, lessons, explanations, questions, games, videos, quizzes and tests. • Skills and competencies need to be be visually demonstrated.

contd. table 1

Phases of Learning Taxonomy	*Learning and Educational Requirements of the Taxonomy*	*Functionalities to Be Built Into the Learning System*
		• Resources such as videos, notes and quizzes – either created in-house or sourced – are accessible to provide learners with a sound context for what is being learnt. These resources need to enhance understanding, not merely presenting isolated facts. • Complex topics are explained in video clips that can be stopped and replayed according to the learner's needs. • Videos needs to take on various forms: either through a person teaching, a practical task, the demonstration of required skills or a revision session. • Learners can download printable study notes. • Internet navigation needs to be available for learners to do their assignments. • Assignments, questions and assessments are built into the system in such a way that learners are informed that certain assignments are due. • Pre-determined questions in the system provoke critical thinking and problem-solving. • Practical tasks require certain skills and competencies from the learners, and learners are enabled to record and upload their practice. • The system has the functionality to avail memoranda and feedback on learner performance once the task has been completed. This allows learners to view mistakes and where to improve. • The system contains a guided learning functionality, which informs learners what to do during a particular period of time, ensuring that they progress at the required pace. • Suggested start and end dates guide learners as to when assignments must be completed; assisting learners to pace themselves, yet remain within manageable timelines. • The system can be adjusted to adapt to changes in the annual programme in order to provide more flexibility to the learner. • Where learners experience problems, the system makes provision for "catch-up" activities or multiple opportunities to improve their performance.

contd. table 1

Phases of Learning Taxonomy	*Learning and Educational Requirements of the Taxonomy*	*Functionalities to Be Built Into the Learning System*
		• The system provides learners with the functionality to work ahead if required. • The lessons on the system occur in a specific sequence, scaffolding on existing knowledge guiding the learner's thinking towards the next step in mastering the subject content.
Enabling activities to be embedded in the learning process (HOW?)	**Learners should be enabled to** • interpret information according to their own reality, • make meaningful connections between existing and new knowledge, • recognise principles and identify relationships, • develop critical and creative thinking skills, • be assessed at different times and by means of different forms of assessment, and • interpret feedback on their progress and performance.	• Lessons are built according to the Future Learn academic model (based on the learning process) by setting challenges, integrating subject content and inducing critical thinking problem-solving, application and reflection. • Lessons consist of a variety of items, including audio, video, quizzes, reading materials and images. • Lessons scaffold on one another, and the system only releases new content once the preceding part has been completed – an adaptive release approach. • The system is designed to ensure that no building blocks are skipped or missed; skills need to be fully entrenched before moving on. • The system provides for formal and informal assessment activities, as well as self-evaluative assessments with immediate feedback on performance. • Learners are able to tick off whether the outcomes/aims have been achieved at the end of a unit. This provides the opportunity to celebrate small achievements and motivates the learner to progress. • Progress tracking will enable learners to gauge their progress against their own goals, but also against peers and the prescribed progress set by the national curriculum. • Feedback on the learners' assessment in the form of progress reports are available on the system platform. • Learners are encouraged to grow accustomed to feedback, as the feedback on their assessments are available on the system platform -enabling the learning cycle to become shorter and faster. • The marks for assessments are transferred onto a marks system, from which progress reports can be generated.

contd. table 1

Phases of Learning Taxonomy	*Learning and Educational Requirements of the Taxonomy*	*Functionalities to Be Built Into the Learning System*
Outcomes to be reached (WHY?)	**To determine whether effective learning has taken place by assessing whether the learners are able to demonstrate the ability to** • construct new knowledge, • engage in higher-order thinking, • apply new knowledge and skills, • identify and solve problems/challenges, • synthesise and evaluate info, and • reflect on *what* they have learnt and *how* they have learnt it.	• The system contains a variety of assessment activities and tools to determine whether learners mastered the new knowledge and are able to demonstrate the required thinking skills. • Though-provoking questions are uploaded onto the system, which challenge learners to apply what they have learnt to real-life situations. • Learners need access to a forum platform where they can share their research finding, reflect on their learning and share key insights. • The system requires a platform on which learners can also participate in discussions, interact with peers and facilitators, and receive feedback. • Rerouting to the correct place where the basic concepts are explained must be easily accessible when learners need to revise previous work or explore it further.

CONCLUSION

Previous research on the needs of distance education learners indicated the need of a learning platform that would optimise independent leaning, assist learners to pace their work, and unlatch the content, formed the foundation of the planning the development of a technology-driven system. The next step for FutureLearn was to explore learning theories and curriculum requirements to ensure that such a learning system would answer to sound learning and educational principles. In facing the challenges related to the development of such an ecosystem, the institution's business development division had to work closely with its leadership team, programmers, and the academic division to develop a system that is educationally sound, yet answer to the trends and benchmarks of technological innovation, as well as to the institutional needs.

Though there are numerous systems in the market, most of them are mere learning tools or learning management systems, developed for the higher education sector. As distance education for the schooling phase is still in its infant shoes in South Africa, and FutureLearn was compelled to address the needs of its learners, stay current, and ensure that the introduction of such a system would not be disruptive to existing operating systems and platforms in the institution. Initially, the institution lacked a clear focus, and, therefore decided to embark on substantial research to infuse the thinking and planning of a learning system, as it was important for FutureLearn that the end-product would be ecosystemic in nature, where the various components form an integrated system that enhances learners' learning experience. As mentioned earlier, the platform and some functionalities are still in the pilot stages. The insights gained from the pilot inform continuous further development. Through this paper, the researchers aimed to provide insight into their own journey, towards the development of a technology-driven learning ecosystem for distance education learners by presenting the framework as culmination of preceding research and the practical implication thereof.

By addressing both the theoretical and the practical concerns of such an endeavour, this paper is an attempt to contribute to the institution itself, but also to contribute to distance education as a mode of delivery, both nationally and internationally.

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