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In Pursuit of Smart Learning Environments for the 21st Century



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Open Note of the IBE

The IBE has launched the series In-Progress Reflections on *Current and Critical Issues in Curriculum, Learning and Assessment* to open a communal space for a global conversation, collective production and discussion on those issues of high concern for Member States. It intends to support country efforts in mainstreaming challenging issues within the processes of curriculum renewal and development across different levels, settings and provisions of the education system.

Initially, the focus areas of the In-Progress Reflections series encompass, among others,: (i) Early Childhood Care and Education (ECCE) as a foundation of holistic child development and learning; (ii) Reading and writing in early grades to support the development of essential competencies; (iii) Youth Culture and competencies for Youth in the early 21st century (covering formal, non-formal and informal education); (iv) ICT curricula and inclusive pedagogy contributing to relevant and effective learning outcomes; (v) STEM (Science, Technology, Engineering and Mathematics) curricula to foster sustainable development; (vi) Curriculum for Global Citizenship Education (peace, human rights, sustainable development, values, ethics, multiculturalism, etc.); (vii) Assessment to enhance and support learning opportunities; and (viii) Inclusive education as an over guiding principle of education systems.

The series of reflections covers a wide array of knowledge products, among them: discussion papers, policy briefs, frameworks, guidelines, prototypes, resource packs, learning tools and multimedia resources. These materials are discussed, refined, used and disseminated engaging education and curriculum agencies / institutes, and in particular curriculum developers and specialists, development experts, policy makers, teacher trainers, supervisors, principals, teachers, researchers and other educational stakeholders. In addition, they serve as reference materials for the IBE menu of capacity-development training on curriculum, learning and quality education – namely masters, diplomas, certificates and workshops – to forge policy and technical dialogue involving a diversity of stakeholders and to support sustainable country fieldwork.

Through blogs and e-forums, we encourage the audience to actively interact and bring in diverse perspectives. Effectively, the online space for reflection allows us to stay connected, facilitates exchange between experts from different regions of the world, and truly fosters continuous reflection on the issues concerned. The blog is structured to gather diverse resources, which include tools and documents (as previously mentioned) under specific themes to provide a complex and rich set of materials targeted to the specific needs of Member States. The In-Progress Reflections will capture relevant visions, views and comments shared by the audience, and serve as a key resource to support Member States' efforts in mainstreaming relevant findings and effective practices in national policies, curriculum frameworks and developments and in professional practices.

Dr. Mmantsetsa Marope: Director, International Bureau of Education



In Pursuit of Smart Learning Environments for the 21st Century

Abstract: Learning environments have changed significantly in the past few decades due to the inclusion of emerging Information and Communication Technology (ICT), both hardware and software, as well as a variety of online media in classrooms. Learners today utilize mobile gadgets and applications as their primary sources of information, knowledge, and social discourse. However, despite these advances in educational technologies and the way learners have adapted to their changing environments, many classrooms today still employ teaching methods of the past: lecture formats, unauthentic assessments, and rote learning. Technology is often used to supplement, rather than drive, the learning environment. The current dilemma faced by education institutions and leaders in the industry, then, is how to lessen the divide between the current learning environment, and the learning traits, skills and expectations of the learners it serves. In order to ensure that learners are provided a relevant and engaging learning experience, it is becoming increasingly vital for such smart learning environments (SLE) to be implemented in secondary and tertiary learning institutions. A SLE is one that features the use of innovative technologies and elements that allow greater flexibility, adaptation, engagement, and feedback for the learner (Spector, 2014). All in all, these technological advancements are potentially revolutionary for the way teachers and learners interact, paving the way for more learner-centred learning environments.

Keywords: E-learning – Information and Communication Technology (ICT) – personalized learning – Smart Learning Environments (SLE) – Technology-Enhanced Learning (TEL)

Introduction

In the past few decades, there has been a fundamental change in the education arena, not so much on the advancement and possibilities of technology-assisted education, but rather on the impact these technologies have on the way our learners interact with their environment, teachers and the concept of learning. Learners of the 21st century come into the classroom with traits, skills, and expectations that differ from the traditional learners' profile. The modern learner is comfortable with higher degrees of technology-enabled learning, and prefers collaborative work, learning environments that are unstructured, and a learning relationship that resembles the power structure of a 'facilitator' – instead of that of a teacher.

Learning environments have definitely changed in the past decades, highly due to the inclusion of emerging Information and Communication Technology (ICT), both hardware and software, and online media in the classroom. However, the vast majority of classrooms still bear a very close resemblance to that of the past - lecture format, long hours, text-heavy, unauthentic assessments, and rote-based learning. Technology is mainly to assist the learning environment, instead of driving it. Today, learners view this paradigm very differently, as technology and mobile gadgets and applications have been their primary source of information, knowledge, and social discourse.

The current dilemma faced by education institutions and leaders in the industry is the divide between the current learning environment, and the learning traits, skills and expectations of the learners it serves. As organizations have always evolved to fit their stakeholders, it is vital that education leaders and institutions start the discourse on implementing technology-enhanced learning environments that are relevant and engaging, and place the learner at the seat of the learning engine. Such learning environments would ideally be adaptive, personalized, and technology-driven, with the ability to provide immediate feedback and guidance along the way.

It is becoming increasingly vital for such smart learning environments (SLE) to be implemented in secondary and tertiary learning institutions, in order to ensure that learners are provided with the best learning experience possible that is not diminished by an outdated and irrelevant learning environment. This article serves as an introduction to SLE. It describes the key principles and criteria that make up a SLE, as well as some examples of successful implementations of SLEs, its methods and the ideas of incorporating SLE elements into a learning environment.

Background

From the first known event of learning and knowledge transfer, to the current technology-enabled world, learning environments have been through a dramatic change. What started with learning outdoors and the immediate environments millennia ago, progressed to learning in physical classrooms, libraries, and schools a few hundred years ago, to the utilization of ICT, mobile gadgets, and rich media a few decades ago. In the 1990's, the education literature was flourishing and was excited to report on capabilities and advantages of integrating technology in education, and the promise of making education available at anyplace, anytime, anywhere (Tucker and Morris, 2011). Since then, ICT has been increasingly strengthening its position as a vital component of learning, which effectively led to new and enhanced modes of learning (e-learning, MOOCs, ubiquitous, and mobile-learning).

Learning institutions and their stakeholders are at a very exciting and equally challenging point in the progression of education, as the next major shift in learning is geared to take place in this generation – a shift brought forward by the learners of today. Powered by a new vernacular – a digital vernacular – 21st century learners are increasingly displaying learning traits, skills, and expectations that are in contrast with the learning environment that has been designed for them. The traditional sage on stage, uniformed classroom design, unauthentic assessment, and gradation methods, as well as lecture laden learning experiences, no longer appeal to the way our learners think, engage, and react with their environments. The customary understanding or notion of a learning environment is quickly associated with designated spaces and places, that have huge repositories of knowledge, information and subject matter experts; classrooms, lecture halls and libraries. While for the most part, education still largely occurs in these physical environments, effective learning environments in the 21st century need to be designed based on our learners' continuously evolving and diverse ways of learning. As stated by Chatti, Agustawan, Jarke, and Specht (2010), 'a fundamental shift is needed towards a more personalized, social, open, dynamic, emergent and knowledge-pull model for learning, as opposed to the one-size-fits-all, centralized, static, top-down and knowledge-push models of traditional learning solutions.'

This is not to say that there has been no significant attention taken to address the changing needs and learning preferences of our learners, as ICT and the use of technology have been effectively incorporated into the syllabus of learning institutions at various levels throughout the decades. Learning environments such as these are referred to as technology-enhanced learning (TEL) and can be used interchangeably with e-learning. Based on the definition provided by the University of Sheffield, TEL is a 'broad approach to using technology to support teaching and learning processes, design and delivery' (p. 2).

Throughout the decades, various technologies have been used to enhance and assist learning experiences. Goodyear and Retalis (2010) further explain that 'technology, in its broadest sense can include both hardware – interactive whiteboards, smart tables, handheld technologies, tangible objects – and software – computer-supported collaborative learning systems, learning management systems, simulation modelling tools, online repositories of learning content and scientific data, educational games, web 2.0 social applications, 3D virtual reality, etc.' (p. 8).

These technologies have progressively been implemented in classrooms from the early 1980's and 1990's, as educational projects focusing on smart education, such as the Malaysian Smart School Implementation Plan, carried out by Malaysia in 1997. This project saw the introduction of computer labs and multimedia courseware with the aim to increasing the quality of education, as well as preparing learners for the workforce demands of the 21st century (Sigh, 2001).

Similarly, Singapore's Intelligent Nation (iN2015) was launched in 2006 with the aim to develop the nation's info-communication capabilities, which include the increased use of ICT in education. The iN2015 manifesto states that 'in the education and learning sector, for instance, learners – both adults and children – will be able to access multimedia information, videoconferencing and new learning resources anywhere, beyond classrooms and lecture halls. Using their personalized devices, they will also be able to customize their learning to the pace they want, whenever they want and wherever they are' (2015, p. 10).

It is worth noting that the use of TEL in education institutions not only does it revolve around the injection of ICT into the syllabus, but it also relies heavily in aligning the teaching practices with the introduction of new technologies. A similar challenge was faced by Professor Belcher during the implementation of the Technology-Enabled Active Learning (TEAL) programme at MIT. For the needs of this programme, MIT built a specialized studio-based learning classroom. After the second year, Professor Belcher realised that the programme was not performing to his expectations and began to break down the problem - as explained by Brown (2005):

'Maybe new teaching practices tuned to this new kind of learning environment were needed. Toward this end, Belcher and his team held a summer workshop to help make the transition from sages-on-stage to mentors in the studio. They asked, "How do you actually do activity-based learning rather than lecturing?" A new set of practices started to emerge from the workshop... Because of its success, the TEAL based studio has now been extended to all freshman physics classes at MIT' (p. 5).

Despite its challenges, the use of technology in education had proven to be a game-changer in almost any classroom or learning environment where it has been implemented. More and more academic and other institutions have begun experimenting with ICT on the promise of engaging, interactive, media-rich, collaborative, and on-demand learning, and this paved the way to incorporating new-age technologies and teaching practices into the learning curriculum.

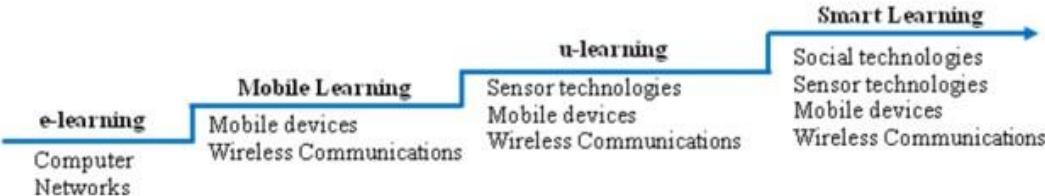
From intermediate use of TEL in the classrooms, to the creation of purely online courses and MOOCs, the way forward definitely includes ICT as a vital component of making learning relevant for the learners of the 21st century.

As the usage of TEL in education increased on one spectrum of the education line, researchers in the fields of computer science heavily focused on research and development of learning systems that are smart (Hwang, 2014). It did not take long for the innovations of computer science and the demands of increased use of ICT in education to overlap. Development in this space paved the way for the implementation of Intelligent Tutoring Systems (ITS) and their related elements into the classroom, with learners given the opportunity to learn from an online or virtual tutor. An ITS is defined by Educause as a 'computer software designed to simulate a human tutor's behaviour and guidance. It can assist students studying a variety of subjects by posing questions, parsing responses, and offering customized instruction and feedback' (2013, p. 1).

Ferster (2014) adds that, 'ITS designs differ significantly from their historical computer-driven predecessors. Rather than the one-size-fits-all strategy of delivering content to a passive learner in those designs, ITS designs are able to customize the learning experience the student receives based on factors such as pre-existing knowledge, learning style, and the student's progress through the content material' (p. 2).

ITS opened the doors to incorporating advanced technologies into the learning sphere and as teaching practices evolved with such technologies, learning environments started getting ‘smart’. SLEs are considered an advanced degree of technology-enhanced environments, with a considerable number of new improvements (Mikulecky, 2012). A graphical representation of the evolution of TEL by Adu and Poo (2014) is presented in *Figure 1*.

*Figure 1: Evolution of technology-enhanced learning: From e-learning to smart learning.*¹



¹ Source: Adu and Poo. 2014. *Smart Learning: A New Paradigm of Learning in the Smart Age*.

Definition of Smart Learning Environment (SLE)

The term smart learning environment (SLE) does not have a completely clear definition as yet, due to its recent incorporation into the TEL environment. However, as discussed, it does encapsulate a set of crucial components. The International Association for Smart Learning Environments defines SLE as an environment that features the use of innovative technologies and elements that allow greater flexibility, effectiveness, adaptation, engagement, motivation and feedback for the learner (Spector, 2014). According to Zhu et al. (2016), 'the objective of smart education is to improve learners' quality of lifelong learning. It focuses on contextual, personalized and seamless learning to promote learners' emerging intelligence and facilitate their problem-solving ability in smart environments' (p. 15).

Gros (2016) adds that 'smart learning is founded on two different types of technology: smart devices and intelligent technologies. Smart devices refer to artefacts that exhibit some properties of ubiquitous computing, including (although not necessarily) artificial intelligence; for instance, the Internet of things, wearable technology in the form of an accessory such as glasses, a backpack, or even clothing' (p. 3). Intelligent technologies refer to learning analytics, cloud computing and AI capabilities, and are vital in capturing valuable learning data that can effectively enhance the development of personalized and adaptive learning (Mayer et al., 2013; Picciano, 2012).

In a SLE, learning can occur anywhere, anytime, at any pace. 21st century schools must, therefore, create a learning environment that provides the necessary learning guidance, hints, supportive tools, or learning suggestions to students (Hwang, 2014; Oblinger, 2005).

Finally, Huang et al. (2013) define a SLE as 'the learning place or an activity space that can sense learning scenarios, identify the characteristics of learners, provide appropriate learning resources and convenient interactive tools, automatically record the learning process and evaluate learning outcomes in order to promote effective learning' (p. 8).

In our point of view, a SLE is an adaptive system that puts the learner at the forefront; improves learning experiences for the learner based on learning traits, preferences and progress; features increased degrees of engagement, knowledge access, feedback and guidance; and uses rich-media with a seamless access to pertinent information, real-life and on-the-go mentoring, with high use of AI, neural networks and smart-technologies to continuously enhance the learning environment.

The definitions provided by scholars and researchers reflect an ideal and perfected SLE, and do not fully demonstrate the current application of SLE in educational institutions. It is common for institutions to use multiple elements or criteria that make up a SLE in their classrooms and there is scope to incorporate many more elements or criteria into emerging SLEs. According to Huang, Yang, and Zheng (2013), there are substantial differences between SLE and common digital learning systems, as shown in *Table 1*.

Table 1. The Comparison of Common Digital Learning Environments and Smart Learning Environments²

	Common Digital Learning Environment	Smart Learning Environment
Learning Resources	<ol style="list-style-type: none"> 1) Digital resources based on rich media; 2) Online access becomes the mainstream; and 3) Users select resources. 	<ol style="list-style-type: none"> 1) Digital resources independent of the devices; 2) Seamless connection or automatic synchronization becomes fashionable; and 3) Deliver on-demand resources.
Learning Tools	<ol style="list-style-type: none"> 1) Tools with all-in-one functions, systematized tools; 2) Learners judge the technology environment; and 3) Learners judge the learning scenarios. 	<ol style="list-style-type: none"> 1) Specialized tools and miniaturized tools; 2) Automatically sensing technology environment; and 3) Learning scenarios are automatically recognized.
Learning Community	<ol style="list-style-type: none"> 1) Virtual community focusing on online communication; 2) Self-selected community; and 3) Restricted to information skills. 	<ol style="list-style-type: none"> 1) Combined with the mobile interconnected real community to communicate anytime and anywhere; 2) Automatically matched communities; and 3) Dependent on media literacy.
Teaching Community	<ol style="list-style-type: none"> 1) Difficult to form a community, which is highly dependent on experience; and 2) Make the regional community possible. 	<ol style="list-style-type: none"> 1) Automatically form community, which is highly concerned about the users' experience; and 2) Make the cross- regional community fashionable.
Learning Methods	<ol style="list-style-type: none"> 1) Focus on individual knowledge construction; 2) Focus on low-level cognitive objectives; 3) Unify evaluation requirements; and 4) Interest becomes the key to the diversity of learning methods. 	<ol style="list-style-type: none"> 1) Highlight the knowledge construction of community collaboration; 2) Focus on high-level cognitive objectives; 3) Multiple evaluation requirements; and 4) Thinking becomes the key to the diversity of learning methods.
Teaching Methods	<ol style="list-style-type: none"> 1) Emphasize resource design and explanation; 2) Summative evaluation of the learning outcomes based on the learners' behaviours; and 3) Observation of learning behaviours. 	<ol style="list-style-type: none"> 1) Emphasize activity design and guidance; 2) Adaptive evaluation of learning outcomes based on the cognitive characteristics of learners; and 3) Intervention in learning activities.

It would certainly prove challenging to measure the degree of 'smartness' in any learning environment, which is the reason most education institutions approach the matter by adhering to attributes, criteria, and elements that define a SLE. This will be discussed and elaborated in the following section.

² Taken from Huang, Yang, and Zheng (2013), p. 9

Attributes of Smart Learning Environments (SLE)

The field of SLE has been actively researched and conceptualized by academics (see Huang, Yang, and Zheng, 2013; Hwang, 2014; Spector, 2014; Zhu, Yu and Riezebos, 2016). They collectively agree that there are specific attributes, criteria, and elements that result in the creation of a SLE.

Huang et al. (2013) focused on the technical features of SLE, which are reflected in the four aspects of tracking, recognizing, having awareness, and connecting, which aim to promote easy, engaged, and effective learning of learners, as explained below:

1) Tracking learning process.

The SLE can track the learning status of learners to enable a more accurate support for learning.

2) Recognizing learning scenario.

Personalized resources will be identified according to the learning event, which includes the learning time, place, peers and activities.

3) Awareness of the physical environment.

The air, temperature, light, sound, and smell will be monitored and adjusted to accommodate learners' needs.

4) Connecting learning community.

Learners will be connected to learning communities to enrich the learning experience.

Spector (2014) suggests that a SLE comprises of the following characteristics:

- 1) Knowledge: ability to access, add and modify knowledge;
- 2) Task support: providing learners with tools, knowledge, and skills to perform a task;
- 3) Learner sensitivity: capitalizing on learner information to suit learner capabilities;
- 4) Context sensitivity: recognizing specific situations, especially those in which a learner is in need of assistance;
- 5) Reflection and feedback: providing meaningful and timely feedback to a learner based on the learner's progress and profile and the learning task at hand;
- 6) Conversation: engaging the learner in a dialogue or facilitate group dialogue on a relevant topic or problem;
- 7) Reflection: generating learner self-assessment and suggesting activities to improve overall effectiveness;
- 8) Innovation: use of new and emerging innovative technologies in creative ways to support learning; and
- 9) Self-organization: the learning environment self-improves with learner interactions.

According to Hwang (2014), the potential criteria of a SLE are as follows:

- 1) Context-aware: able to sense the learner's learning environment;
- 2) Adaptive and instant learning support: personalizing learning to the learner (this includes providing feedback, adapting to learning style, giving hints, etc.); and
- 3) Adaptive and instant technology support: user interface, use of different technology tools.

Zhu, et al. (2016, p. 11) echo a similar description as Hwang on the criteria that make up a SLE, however Zhu added additional layers to his set of criteria, as explained in *Table 2* below:

Table 2: Criteria for a Smart Learning Environment

Criteria	Description
Location-aware	In smart learning, the location in real time is important data that the systems need in order to adapt the content and situation to the learner.
Context-aware	Exploring different activity scenarios and information.
Socially-aware	Sensing social relationships and providing platforms for exchange of ideas, knowledge, know-how, etc.
Interoperable	Setting standards for different resources, services and platforms.
Seamless connection	Providing continuous service when any device connects.
Adaptable	Pushing learning resources according to access, preference and demand.
Ubiquitous	Predicting learner demands until clearly expressed, providing visual and transparent access to learning resources and services.
Whole record	Recording learning path data to mine and analyse in depth, then providing reasonable assessment, suggestions and pushing on-demand service.
Natural interaction	Transferring the senses of multi-modal interaction, including position and facial expression recognition.
High engagement	Immersion in multi-directional interactive learning experiences in technology-enriched environments.

Zhu et al. (2016) add that, ‘a smart learning environment aims to support learners to obtain new knowledge, even while they are engaged in leisure activities. It plays the role of a coach, or guide, who seeks opportunities to advise learners on their daily life by taking their needs and preferences into account. To sum up, the goal of a smart learning environment is to provide self-learning, self-motivated and personalized services’ (p. 12).

This is not to imply that a SLE can only exist if all the above attributes are included into the education mix. The various attributes, criteria, and elements that make up a SLE can take on many different forms and functions in any learning environment. Here two learners in their respective SLEs are introduced:

Consider a learner, John, who is going home after school. As John passes through a garden, the learning system identifies that one of the trees is related to what he has learned in school during his natural science course. Moreover, John has mentioned that he would like to see the real trees if possible. As there is still plenty of time for John to get home for dinner, the learning system reminds him to note the tree and provides him with some relevant learning materials. In addition, the learning system recommends that he does a learning task, that is, to complete a concept map about the ecology of the target tree based on his observations of the tree as well as what he has learned from the textbook.

Consider another learner, Esther, who is part of an exchange learner programme in Malaysia. On her way back home after her Malay language class, the learning system detects a nearby convenience store. As Esther failed to pass a Malay quiz on grocery items available in convenience stores earlier in her Malay class, the learning system tries to situate her in the real-world scenario to help her master the Malay terms; therefore, it guides her to the convenience store and finds the location of those items. Following that, some learning tasks are conducted in order for her to practise some relevant English terms. For example, the learning system might give some frequently used sentences in the convenience store and encourage her to interact with the worker to practise her English.

Designing Smart Learning Environments (SLE)

How does one design a SLE? Wu, Lee, Chang and Liang (2013) identified seven modules/areas that are necessary:

1) A learning status-detecting module.

This module detects learners' real-world status (e.g., locations and learning behaviours) and environmental contexts (e.g., temperature and humidity) via connecting to some sensing devices.

2) A learning-performance evaluation module.

This module evaluates and records learners' performance by conducting tests online or in the real world.

3) An adaptive learning task module.

This module assigns learning tasks to learners based on their learning progress, learning performance, personal factors and their learning objectives in all disciplines.

4) An adaptive learning content module.

This module provides learning materials to learners based on the learning progress, learning performance, personal factors and the real-world status of individual learners.

5) A personal learning support module.

This module provides learning support to learners based on their learning needs.

6) A set of databases for keeping the learner profiles and portfolios.

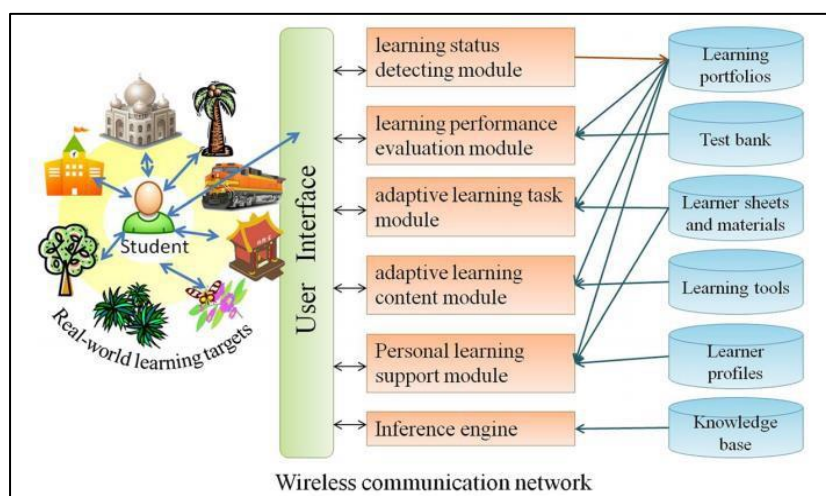
The data in those databases are very helpful to the learning system in terms of providing suitable support to the students in the right place and at the right time.

7) An inference engine and a knowledge base for further learning inferences and support.

The knowledge base is a collection of teaching and learning experiences and might contain decision-making rules. The inference engine is a decision making computer program that analyses the current case based on the rules in the knowledge base.

A graphical illustration is as follows:

Figure 2: Framework of a Smart Learning Environment³



³ Source: Hwang, 2014, p. 7

Implementation of Smart Learning Environments (SLE)

Intel

Intel has been at the helm of transforming education and learning environments since the early 1990’s and has been focusing on the education industry centred upon professional development of teachers as well as deployment of hardware, software and related ICT solutions, with the aim of creating an interactive, engaging and more vibrant learning environment (Price, 2015). Throughout Intel’s efforts and research in this field, and over years of gathering data, Intel has proposed a model for educational transformation. This model, as explained by Price (2015), ‘was developed to reflect evidence-based best practices that have emerged from Intel’s collaborations with school systems and governments in more than 100 countries to address the practical approaches to deep, large-scale, systemic change with ICT, to create sustainable improvements in student learning’ (p. 5).

Table 3 below further explains each element and the position it plays in ensuring that education institutions can effectively transform their traditional classrooms into SLEs.

Table 3: Smart Learning model for educational transformation

Element	Description
ICT	It is the most important foundation for systemic change. Connecting different technology systems and making a composite whole using AI technology is important. Innovative use of analytics and big data will ensure the learning systems are incrementally smarter.
Curriculum and Assessment	Curriculum activities should maximize the potential of technology. Learning designs need to be improved based on new innovative technologies. Various different assessment types can be incorporated into the learning process.
Professional Development	Educators, like students, thrive when given the proper tools, training, and inspiration. Professional development resources that make the most of modern, personalized learning environments and technology tools enable effective use of today’s technologies.
Leadership	Vis-à-vis the phenomenal development of technology, it is important that leaders are expertly conversant with the changes technologies are bringing into the classrooms and provide appropriate support. Like teachers and students, leaders need to be trained as well.

Policy	<p>Two transformative initiatives that have influenced education policy around the world in recent years have been:</p> <ol style="list-style-type: none"> 1) The UN Millennium Development Goals; and 2) The OECD Programme for International Student Assessment (PISA). <p>Both of these initiatives have had a considerable impact on how individual governments approach education policy issues and approaches.</p>
Research and Evaluation	<p>Continuous evaluation and improvement using refined M&E methods is crucial for the evolvement of effective SLEs.</p> <p>Research on more futuristic SLEs should be driven by data and analytics.</p>
Sustainable Resources	<p>Long-term sustainability is important and this will depend on wise decisions with regard to technology.</p> <p>This will be measured by sustained 'value and drive' on student performance.</p>

Hamdan Bin Mohammed Smart University

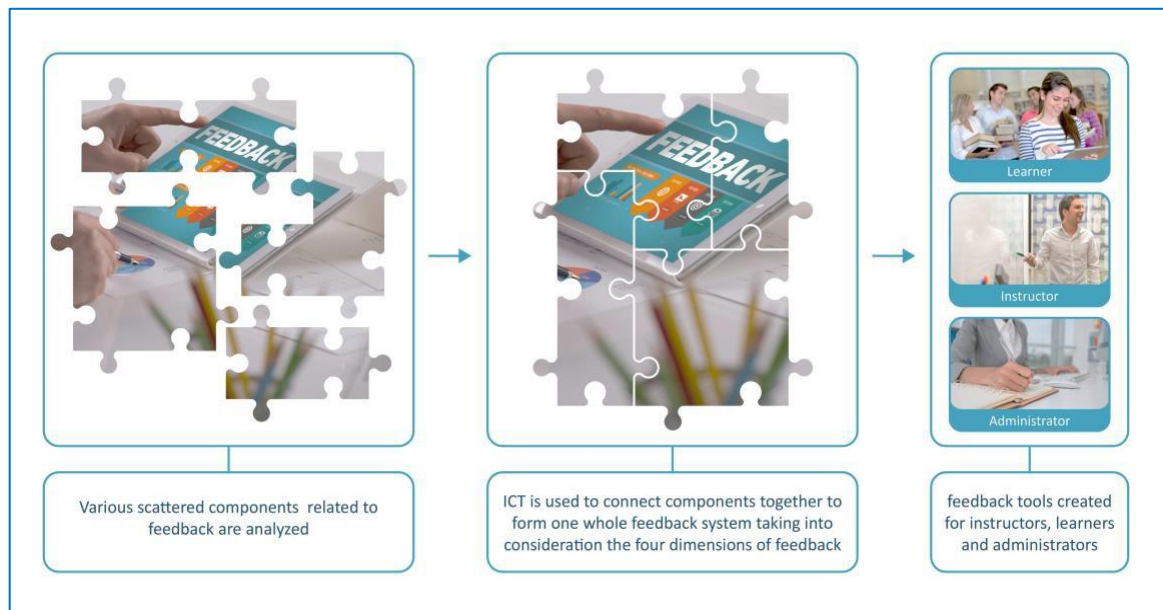
Hamdan Bin Mohammed Smart University (HBMSU) has built numerous smart technological tools to assist faculties in the design of smart learning, to assist the registrar to identify and suggest courses to learners, examination schedules, and final grades as well as to assist the financial systems to check and alert learners on their financial status. For this section, the discussion around smart learning will focus on systems of assessment and feedback. This follows the fifth characteristic stated by Spector (2014) above - reflection and feedback: providing meaningful and timely feedback to a learner based on the learner's progress and profile and the learning task.

HBMSU is the leading Arab University in online and blended learning in Business and Quality, Health and Environmental Sciences and Education. The university's vision is centred on shaping education and learning using innovative solutions. To achieve this, HBMSU has implemented a unique blended learning environment suited in the Arab culture and needs of learners in the United Arab Emirates (UAE). In an effort to popularize smart learning (especially related to feedback) the following types of feedback were created within the feedback system: feedback on task during the learning process; feedback on assignments, and feedback within digitized learning objects. These various feedback types enabled learners to reach the stated learning outcomes either individually or collectively. Theory states that good feedback assists learners to enhance meaning-making by making sense of content and its applications in an integrated manner. In order for this to happen, the learning structures have to be well conceptualized and personalized to allow individual learners to integrate new knowledge into existing schemas. HBMSU laid emphasis on the above findings, whereby various technology tools have been especially created to enable faculty to efficiently design, develop, and deliver learning. In short, HBMSU strongly believes in the smart application of technology to enhance learning and in the importance of feedback regarding this smart use of technology.

Receiving and acting on feedback by a learner in the continuum of online learning needs a smart ICT-backed system for immediacy of communication and historical availability of interactions as the very nature of online learning dictates that learners and instructors are distanced and learner isolation, motivation and re-visit of learning is an important factor. In such an environment, speed, efficiency, and effectiveness are crucial and can only be achieved if the system has been created to support the curriculum ideals. The design of the feedback system started with the conceptualization of a progressive curriculum and syllabus, broad and specific learning outcomes and use of advance and

innovative learning designs. Once these were in place, the learning design team, faculty members, and the IT team brainstormed ideas to define and structure IT support systems to support feedback to ensure learning achievement and whole-person development. As such, the following kinds of feedback systems were proposed based on the literature propagating the importance of various feedback dimensions which are crucial for online learners (Narciss, 2004), namely: error identification and correction, giving the correct answer or solution, task improvement feedback and in-depth information feedback. To enhance the feedback system, disparate feedback components were connected using smart ICT as illustrated in *Figure 3* below:

Figure 2: Conceptualization of a Smart Feedback System at HBMSU



The following feedback systems were then created:

1) Feedback given on assignments:

- Assignments form part on on-going assessment at HBMSU.
- Within the assignment folders, there are special in-built tools, which assist HBMSU instructors to carefully define the properties of the assignment to facilitate different types of feedback.
- For example, *Turnitin* can be easily activated with an option for learners to upload draft written assignments so that they get feedback on the assignment and on similarity checks.
- The assignment tool also has features to enable learners to upload their final assignments without disrupting the feedback mechanisms.
- Instructors get easy access to learner assignments and provide the necessary feedback within the system.
- Learners received email alerts about the feedback, they access the system to view the given feedback.

2) Feedback on tasks and these included:

- Feedback on blogs created by learners.
- Feedback on Wikis, which are essentially knowledge creation projects. Co-creation of knowledge is emphasized.

- c. Feedback on online forum discussions which encourage reflection, collaborative learning, and discovery learning based on in-built rubrics.
 - d. Feedback on quizzes. The VLE allows for creation of automated feedback to suit various quiz activities which can be given as self-challenge or as self-test.
- 3) Automated and immediate feedback in HBMSU LCMS Learning Objects. This feedback is related to the following two dimensions of feedback: error identification and correction as well as giving the correct answer or solution:
- a. A total of 2200 integrated, digitized learning objects have been especially created based on learning outcomes.
 - b. The feedback is given to check mastery of concepts and application of skills.
 - c. The feedback is immediate and contingent on the response given.
 - d. The feedback is captured in the VLE and a report is generated and can be viewed by instructors and administrators.

This project achieved the integration of different feedback components into one feedback system. However, it is still bounded by our own system, which could be enhanced using emerging trends especially those related to gamification and personalized learning.

Currently, HBMSU is working on the gamification project which was launched on 16 November 2016 during the UAE Innovation Week. The idea of gamification is focused on the feedback components to increase engagement during the learning process through immediate feedback.

Conclusion

The evolvement of SLE charts another exciting and important era in the total TEL initiatives. The technological advancement is extremely promising for educators, which technically means that more research, more sharing, and more continuous development of educators are needed.

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