TRANSFORMING THE DELIVERY OF CURRICULUM IN THE CARIBBEAN SIDS THROUGH MOBILE LEARNING

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Abstract*:* Mobile devices and mobile technologies are significantly impacting the field of education. The dynamics of mobile computing is transforming the landscape of traditional classrooms. Education is a major factor in developing and sustaining a country. In a fast paced environment, traditional classrooms can be a hindrance to higher education. Mobile learning has the capacity to provide effective pedagogical and suitable learning activities for students of higher education. This paper explores m-learning and the shift of focus that it brings to educators and students. It looks at the relevance and place of m-learning in higher education, the framework for design as well as the devices and technologies that are available for use. The pedagogical approaches, assessment techniques and training that are suitable for the mobile environment are explored. The use of mobile devices allows for a level of flexibility that allows students to access education anywhere, anytime. Mobile learning provides a way for educational institutions to deliver educational content to its students on any platform, anyplace and at the time of need. For the design and implementation for mobile learning, the design approach was the point of focus. The relevance of mobile learning to Small Island Developing States and the future was highlighted.

Keywords: *devices, education, learning, mobile, technology*

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1. Introduction: Education in Sustaining Development

[1] (The United Nations Educational, 2015) stated on page three that 'Education is key to the global integrated framework of sustainable development goals'. Education is a fundamental right of children and the progress of a country is dependent on having a skilled and educated workforce. There is no singular powerful transformative force as education – it promotes human rights and dignity, aids in the eradication of poverty and deepens sustainability, to build a better future for all. It was also highlighted that the aspiration of sustainable development requires us to resolve common problems and tensions and to recognize and capitalise on new horizons. Economic growth as well as the creation of wealth has been noted to reduce global poverty rates, while unsustainable patterns of economic production and consumption contribute to global warming, environmental degradation and an upsurge in natural disasters. Therefore, if SIDS in the Caribbean forge

partnership, leadership and make wise investments in education, we can transform individual lives, national economies and by extension our world.

2. Tertiary Education and Country Development

2.1 Country Development

SIDS in the Caribbean can be classified as developing countries according to [2] (Sherpa, 2016) who defines developing countries as those that are working their way up the ladder of economic performance, living standards, sustainability and equality that differentiates them from so-called developed countries. The determining factor for a country to be classified as developed is either a judgement call or statistical line that is based on a combination of development indicators. However, one of the driving forces behind achieving developed status is education.

2.2 Education in Sustaining Development

It is stated in [1] that the aspiration of sustainable development requires us to resolve common problems and tensions and to recognize new horizons. Economic growth as well as the creation of wealth has been noted to reduce global poverty rates, while unsustainable patterns of economic production and consumption contribute to global warming, environmental degradation and an upsurge in natural disasters. [1] (The United Nations Educational, 2015) also stated on page three that 'Education is key to the global integrated framework of sustainable development goals' and 'There is no more powerful transformative force than education – to promote human rights and dignity, to eradicate poverty and deepen sustainability, to build a better future for all, which is exactly what is needed by SIDS in the Caribbean to move towards becoming developed countries.

[3] (Jahan, 2016) highlighted that SIDS exist in a global village where human development outcomes are dependent on the actions at the national level, as well as by the structures, events and work at the global level. The current structure of most tertiary institutions in SIDS are still very traditional. The classes are conducted face to face therefore students must sit in a physical classroom and listen to a lecturer deliver a lesson. This situation presents a limitation to 'poor and vulnerable' because they must make a choice of attending classes or working to gain an income to sustain their livelihood. This creates a domino effect leaving these persons economically insecure because of a lack of higher education they miss out on promotion opportunities. This creates a lingering conflict of choosing between pursuing higher education to achieve economic security or working to sustain themselves and their families.

2.3 Factors Hindering Tertiary Education in SIDS

According to [4] (Shen, 2017) one of the major factors that directly impacts tertiary education in the Caribbean is insufficient revenue generated from the economy. In this article he also stated that the cost of higher education in developed countries are usually subsidized by the state, for citizens of that country, however in the Caribbean only a small fraction of subsides are offered by the government. This means that the high cost attached to higher education is usually a deterrent to enrolment in the Caribbean.
[4] (Shen, 2017) concluded that the four main factors that affect higher education in the Caribbean are:

1. Increasing unit of instruction
2. Increasing enrolments

3. Low level of government revenues joint with regular financial obligations of the country
4. Increased privatization in higher education.

It is therefore necessary that a solution comes forward to ensure that these hindering factors are addressed. The introduction of mobile technology and in particular smart devices can directly address and assist with increasing enrolment.

3. Background on Mobile Learning

[5] (Tinio, 2003) defined e-learning as formal and informal learning that uses information networks, namely the Internet, or an Intranet or an extranet, whether wholly or in part, for course delivery, interaction and / or facilitation. Mobile learning is a subset of e-learning.

[6] (Beal, Mobile Learning (m-learning), 2018) said that mobile learning m-learning) is education via the Internet or network using personal devices, such as tablets and smartphones to obtain learning materials through mobile apps, social interactions and online educational hubs. The use of mobile devices allows for a level of flexibility that allows students to access education anywhere, anytime. M-learning provides a way for educational institutions to deliver educational content to its students on any platform, anyplace and at the time of need.
Mobile technologies offer a wealth of opportunities for distance learning and it enables persons to collaborate anywhere at any time. With m-learning the learning affords the learner full control of their learning environment since they can access information and learning material whenever they want. [7] (Ally, 2009) said that students have full control of when they learn and from where. Students are empowered since they do not have to wait for a particular time to attend a particular class to access learning material.

4. Framework for Mobile Learning

[8] (KOOLE, 2009) said that the Framework for the Rational Analysis of Mobile Education (FRAME) model describes m-learning as a process resulting from the convergence of mobile technologies, human learning capacities and social interaction. This model takes into consideration contemporary pedagogical issues of information overload, knowledge navigation and collaboration in learning. This model can be used to guide the development of future mobile devices, the development of learning materials and the design of teaching and learning strategies for mobile education for tertiary education in SIDS.

[8] (KOOLE, 2009) also stated that the FRAME model views the learning experiences within a context of information, because collectively and individually learners consume and create information. The interaction with information is then mediated through technology. It is through the complexities of this kind of interaction that information becomes meaningful and useful. This makes this model ideal for m-learning in tertiary education, because it is also necessary to prepare course information within a context that is relevant. Figure 1 shows a graphic representation of the FRAME model.

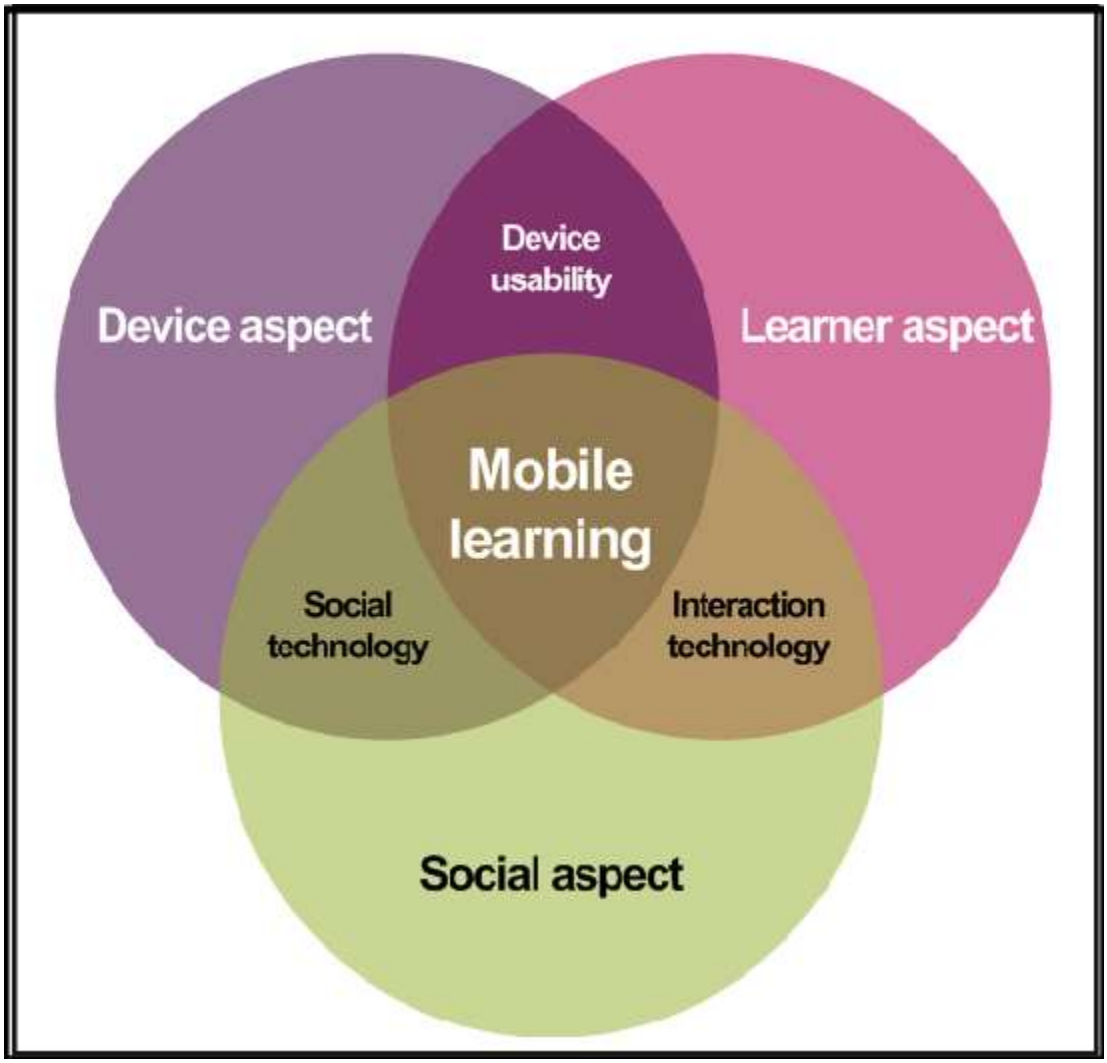

Figure 1 – FRAME Model for Mobile Learning

The three main components are Device, Learner and Social aspects. However, these components aren't disjointed but there are areas of intersection, which contains attributes that are present in both or all three aspects. The attributes of the device usability and social technology intersection describe the affordances of the mobile technology, while the interaction learning intersection contains instruction and learning theories with an emphasis on social constructivism. The primary intersection of all three aspects, defines an ideal mobile learning situation. [9] (Umera Imtinan, 2013) also pointed out that in addition to conforming to the pedagogical requirements, m-learning instructional designers are also considering the nature of learning activities to engage learners with miniature mobile devices, which is prevalent throughout SIDS in the Caribbean. Additionally, they stated that there are a number of m-learning characteristics which are crucial to m-learning design in order to harness the power and accordance's of mobile devices as well as maintaining the learning element as the main focus. These characteristics are essential and should be followed by the designers of the m-learning course content.

5. Mobile learning with Smart Devices - Development and Testing of Pedagogical and System Support

5.1 Pedagogy and Mobile Technology

[8] (KOOLE, 2009) pointed out that one of the main barriers of learning in distance education is the absence of interaction in a learning environment. The distance education character of individual form of learning and the absence of interaction is a challenge to both students who are in need of help and the lecturers who desire to assist students in their cognitive development. However, the key to the successful enactment of interaction in distance education rests on the philosophy of distance education, which informs the decisions about techniques and technology that is most effective.

5.2 New Aged Learner

The challenge of a lot of universities resonates within the area of distance education, therefore the responsibility lies with them to find innovative ways to support students, who are not only geographically distant from the lecturers but also the sources of information and their peers. To address this issue many universities, especially in developing countries have used a number of intervention programs such as tutorial, counselling and peer-group support to enhance interaction. [10] (Makoe, 2012) pointed out that a constant exposure to digital technologies, gadgets, games and mobile devices has arguably evolved a new breed of students, commonly called 'digital natives', and these learners think and process information fundamentally differently from their predecessors, the 'digital immigrants', whose interactions with technology is not innate. This presents to tertiary institutions a new transport system for course delivery, since living in the information age brings with it the desire for knowledge and information which is readily available through online technology. [11] (Nation, 1989) noted that websites, blogs, social networking sites and other electronic media have a wide reach and facilitates in both formal and informal learning. This is a viable option and might be exactly what is needed for the tertiary learner to engage in future learning.

5.3 Pedagogical Intervention of Distance Education

[12] (Rachel Cobcroft, 2006) said that to understand how mobile technology can be appropriated for teaching and learning at a distance, we should start by looking at how different m-learning is from other technologies that are used in teaching and learning. The strength that comes with using mobile technologies is that they offer learning that is intimate, spontaneous, pervasive and versatile to the learners. [13] (Sian Halliday-Wynes, 2009) states that m-learning provides an enhanced cognitive environment in which distance learners can interact with their instructors, their course materials, their physical and their virtual environment. [14] (Laurillard, 2007) highlighted the distinction between m-learning and other technologies is that it has the ability to support situated learning. This provides students with the opportunity to engage in authentic activities, where they can explore, share and interact with each other, as they learn together in their real life learning environments, while covering course material.

5.4 Pedagogy and Technology

It is important that the technology chosen aligns to the pedagogical principles of learning, otherwise it will become 'another resource'. [8](KOOLE, 2009) highlighted the following with respect to pedagogy and technology:

- Identifying learning objectives in a technology-based instruction requires the teacher to select and /or adapt instructional technology to match the objectives based on the students' needs.
- Presenting instruction using technology as part of the instructional process requires the teacher to choose methods that are relevant to the objectives, the technology selected, learning styles modes and pace of learning.
- Evaluating technology-based instruction means that the teacher must select appropriate evaluation techniques that are relevant to the objectives, methods of instruction and technologies used.
- Designing follow-up activities using technology needs teachers to select appropriate material that are relevant and easy for the students to access.
- Locating sources of additional instructional materials means that the teacher must use the Internet and multimedia networks to develop learning materials and expand instructional resources aimed at broadening the knowledge and skill gained.

These considerations links back to Bloom's Taxonomy and how it has impacted the activities that teachers design and use as learning activities. In order for m-learning to be successful [15] (Kukulska-Hulme, 2005) pointed to these three principles: excellent learning and teaching materials, high quality student support services and efficient logical systems. For tertiary education excellent learning and teaching materials must be planned in such a way that the students are supported cognitively, and not left in a vacuum.

5.5 Pedagogical Perspectives of Mobile Learning

Advancements in technology has dramatically changed the tools that are used in the teaching and learning process, however the methods of teaching and learning have not. Institutions must find a way to apply traditionally cognitively grounded teaching methods to m-learning. When it comes to pedagogical aspects of m-learning, it is imperative to find ways on how mobile tools can be integrated into teaching and learning activities. [16] (Okojie, Olinzock, & Okojie-Boulder, 2006) stated that the four key aspects for pedagogical framework for m-learning are:

- Integration of tools
- Pedagogical approaches
- Assessment techniques
- Teacher training

Figure 2 shows a graphical representation of this framework.

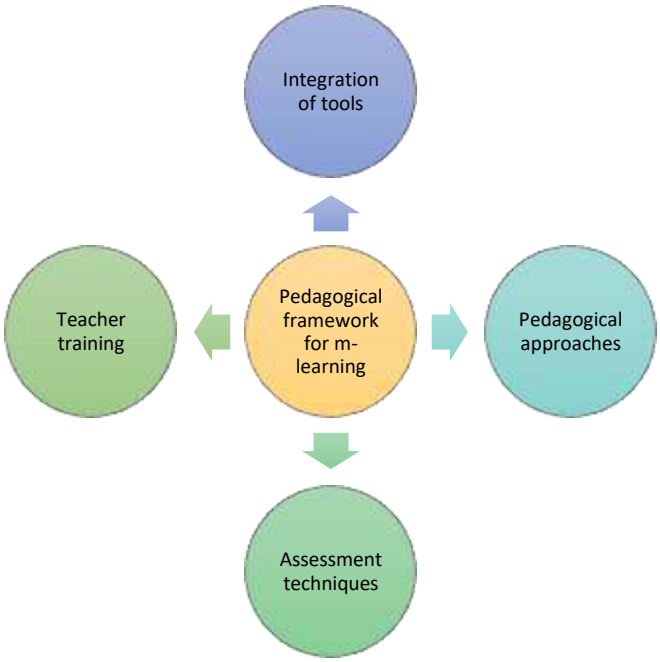

Figure 2 Framework for m-learning

5.6 Technologies in Mobile Learning

[17] (Aniket Srivastava, 2017) highlighted that along with the developments in information technologies, wireless communication and mobile devices have been incorporated to provide support to traditional learning. However the capabilities of these technologies are allowing much more than mere support.

5.7 Mobile Devices

[18] (Ozdamli, 2012) defined a mobile device, commonly known as a handheld computer, as a handheld tablet or other device that is made for portability and is therefore both compact and lightweight. The features of these devices such as date storage, processing and display technologies have afforded these small devices the ability to do nearly anything task that previously needed a personal computer.

[19] (C. Wang 2003) said that in modern day mobile devices applicable to teaching and learning can be outlined as follows.

1. Laptop – this will include any variation such as the notebook, are portable devices that are used in our daily life. Laptops are designed with the same capabilities of a personal computer and the price range has become almost on par with them. Laptops enable users to obtain connectivity through wireless connection types such as wireless network, Bluetooth, USB and infrared devices, independent from time and place.
2. Tablet PC – has become very popular of recent times and it is a portable computer that is typically smaller than a notebook computer but larger than a smart phone. It typically has a touch screen of 7 or 10. Inch and it is easy to transfer data via memory device or the Internet.

3. Personal Digital Assistant (PDA) – also known as palmtop computer is a mobile device that functions as a personal information manager such as keeping addresses or names. It has the ability to connect to the Internet and it's portable.
4. Smart Phone – is a communication device that has been designed by adding features of the PDA to a mobile phone. Smart phones run of a mobile operating system and contain many applications thus making them useful in all areas for different purposes.

With the developments in electronics and computer technology, the size of computers has become smaller with increasing features. Most, if not all, SIDS in the Caribbean have access to these mobile devices.

5.8 Mobile Technologies

[20] (Techopedia, 2018) defines mobile technology as the use of communication infrastructures, protocols and portable devices that enables the users to communicate, study or work flexibly in terms of time and place. [21] (Idris Goksu, 2013) stated that a mobile device loses some of its power without online communication or communication with other devices. To ensure that mobile devices can perform optimally, the following mobile technologies are needed.

[22] (Global, 2018) defines General Packet Radio Service commonly called GPRS as a packet-based mobile data service on the global system for mobile communications (GSM) of 3G and 2G cellular communication systems. It is a non-voice, high-speed and useful packet-switching technology intended for GSM networks. This technology enables connection depending on Internet protocols that supports a wide range of enterprises, as well as commercial applications. It also has the capacity to send and receive compact data bursts and large volumes across mobile phone networks.

Wireless (Wi-Fi) is defined by [21] (Idris Goksu, 2013) as the wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. Mobile devices connect at high speed to the Internet without a physical wired connection.

[20] (Techopedia, 2018) defined Bluetooth as a short-range wireless communication technology that allows devices such as mobile phones, computers and peripherals to transmit data or voice wirelessly over a short distance. The purpose of Bluetooth is to replace the cables that usually connect devices, while still keeping the communication between them secure. Many mobile devices come with Bluetooth radios embedded in them and those without can become Bluetooth enabled by adding a Bluetooth dongle. By broadcasting a device presence and pairing with another device, users can share information.

(Beal, Mobile Learning (m-learning), 2018) defines Infrared as a wireless mobile technology that is used for device communication over short ranges. It requires line-of-sight and has a short transmission range and cannot penetrate walls. This is a major limitation that prevents it as being part of mobile learning for distance education.

Augmented Reality is one of the most recent technologies that increases the application and efficiency in mobile devices such as smart phones, tablet PCs, desktops and Internet-based application. [22] (Pinola, 2018) outlines Augmented Reality (AR) as an interactive device between human and computer, which has been developed by a computer in real world environment. AR technology has proved to be innovative and efficient technology when applied to problem solving. (Techopedia, 2018) said that AR technology can be used in m-learning by means of smart phones

that includes video camera and Internet connection or thorough a GPS technology it makes learning conscious, easy and unlimited. [23] (A.Y.C. Nee, 2012) stated that this technology arouses interest among learners and reinforces learning. AR technology is very important with respect to being user-centred, visualizing the processes it does and providing real-time feedback.

Mobile Cloud Computing is defined by (Idris Goksu, 2013) as a cloud-based data, applications and services designed specifically to be used on mobile and / or portable devices. It enables the delivery of applications and services to mobile users that are powered from a remote cloud server or environment. Although the mobile device is equipped with active apps and resources all or most of the processing is done on a remote mobile cloud sever and all applications bare accessed through the browser rather than locally on the device. This is ideal for students since the cloud enables the user to access and use applications that may not be supported by their platform and that may require computational power beyond that of what the mobile device can support.

Mobile Cloud Computing supports m-learning since it provides common data sharing among the data processing devices through its performance to deliver data online. [24] (T.L. Chou, 2012) highlighted that mobile cloud computing offers a wide range of opportunities for the mobile service sector by making computing resources available in mobile devices on a data network. (Techopedia 2018) added that m-learning devices and technologies instantly provides interaction between the learners and the teachers, among classmates or with learning systems. This allows for the learning devices to be used intensely in managerial and educational processes in many associations, and they also play an important role in developing interaction within the classes or outside the classes of educational institutions.

Implementation of a combination of these technologies in presenting tertiary courses would serve as an invaluable tool.

5.9 Pedagogical Approaches

The excitement of learning through mobile devices with the absence of sufficient involvement of pedagogy to support m-learning will pose challenges to the educators. The emphasis must not be centred on the tool.

[25] (L. Yang, 2012) defines pedagogy as the study and theory of the methods and principles of teaching and how these influence student learning. Pedagogy guides educators teaching strategies, actions and judgements by taking into consideration theories of learning, understandings of students and their needs and the backgrounds and interests of individual students. [26] (C. Wang, 2003) stated that mobile technologies and mobile devices have shifted the control from educators as the owners of knowledge, to the learners as knowledge seekers and creators. [27] (Collins Dictionary, 2018) highlighted that this shift in power must influence educational content and methodology, since learners' active engagement changes the curriculum and how it is delivered. Pedagogical approaches such as constructivism, blended learning, collaborative learning and active learning help forms the foundation for sound pedagogical development with respect to m-learning [28] (Berge, 2017).

6. Implementation of Mobile Learning in Higher Education

[29] (R.J. Shavelson, 2003) said that active implementation and use of new mobile devices and learning technologies, design of electronic educational resources of the new generation are necessary for attaining the strategic objectives of a country.

[30] (Allan Collins, 2004) highlighted the important benefits of the implementation of m-learning in the higher education process as follows:

- Ubiquity – the possibility of obtaining information online
- Availability – access to personal and learning resources through wireless network
- Convenience – the possibility to store personal data and necessary learning materials in mobile devices, instant connection to the Internet through a mobile phone

Access to curricula and programs, academic progress and attendance reports, results of session, workload, timetable for a student and teacher among others, is gained through the mobile devices. M-learning also makes provision of distributed online access to content such as webinars, podcast, electronic magazines, personal library of educational resources, etc.

[31] (Vera I. Toktarova, 2015) concluded that the experimental work suggested the effectiveness of the designed m-learning system that contributes to the improvement of educational and methodical support of the university educational process. Tertiary institutions across SIDS in the Caribbean must be cognizant of the fact that developing the m-learning system must be efficient and there should be quality analysis of mobile learning process. The design of mobile learning tools and resources, will contribute to the implementation and success of lifelong learning.

7. SIDS and M-Learning

[31] (Vera I. Toktarova, 2015) stated that the degree that ICTs are now so central to the global economy and society, they are of great importance to all states and even more so to SIDS because of their smallness and isolation from the major centres of production and consumption. He added that too many SIDS lag in their tertiary education development conventional tertiary teaching methods will simply take too long to raise these states' levels. Distance and flexible learning was singled out as the quickest route to widen access to tertiary education.

The most successful use of ICT in tertiary education in SIDS in the Pacific and the Caribbean has been in distance and flexible learning. The University of the West Indies which is owned and operated in sixteen territories and the University of the South Pacific, owned and operated by twelve states, have been providing distance education in their respective territories since 1970s. With improvements in technology and the recent availability pf greater bandwidth, technology is now used much more intensively. Video-conferencing has enabled postgraduate courses to shift towards a blended learning approach.

Technology has been used to make higher education more accessible, but it has not been fully integrated into the total learning system in many SIDS. There is a need to move beyond using technologies primarily for access purposes, such as student portals for checking grades or registration status or simply downloading a course outline or lecture notes.

8. Future of M-Learning and SIDS

(Vera I. Toktarova, 2015) said that SIDS need to embrace technology and the great potential that it possesses and move in the direction of fully integrating it into the total learning system, by fundamentally altering both the economics of learning and the nature of pedagogy. This remains one of the most challenging and perhaps rewarding component of harnessing technologies for tertiary education. This needs deep commitment of managements and senior academics and considerable sustained staff development to take on the challenge of designing and implementing m-learning courses for higher education.

Making m-learning a success at the University of the West Indies campuses is an attainable goal. The pedagogical framework of m-learning, integration of tools, pedagogical approaches, assessment techniques and teacher training can be implemented at these campuses. Research has shown that implementation usually starts on a small case and can be expanded depending on the success of the prototype. This is the best time to build and implement a prototype.

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