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A Jamaican E-Learning Case Study

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1. Introduction

The use of e-learning technologies to promote effective and flexible learning has become common place at single institutions of learning, at specific educational levels or at the national level. According to Kearns (2002, p.ii) the information age has created a new role for training and education:

> *"the impact of globalisation, information and communication technologies, and the accompanying shifts in the economy, labour market, and in the operations of enterprises have led to fundamental changes in the economy and society that have profound implications for the role of education and training."*

The extent to which the inhabitants of a country are educated can influence its survival (Bashar and Khan, 2007; Bates, 2001). The use of technology in education is believed to have the ability to create the change that is needed in teaching and learning processes and which, in turn, can transform human capital (Barr and Tagg, 1995; Cooper, 1993; Glennan and Melhed, 1996). Thus many governments in developed and developing countries have used technology in education as a way to guide the transition to the information society (Higgins, 2002).

The popularity of e-learning may be due to perceived or realized benefits associated with its use (Bashar and Khan, 2007; Glennan and Melhed, 1996; Haddad, 2001; Higgins, 2002; Naidu, 2006; Zahran, 2003). The statistics highlight the growing popularity of e-learning showing a dramatic increase in the size of the worldwide e-learning industry. The 2012 Ambient Insight Report highlights that the worldwide market for self-paced eLearning reached $35.6 billion in 2011 and is projected to increase to $51.5 billion by 2016 (Adkins, 2012). It goes on further to suggest that there are disparities between countries in terms of their progress with the use of e-learning. As Adkins(2012) indicates, there is relatively high growth rate of 14.6% for developing regions such as Latin America with revenues projected to double by 2016. The report further rationalizes that the projected growth in this region relative to the rest of the world is higher because the region is more of a consumer of e-learning goods and services compared to being a supplier. The majority of its content and technology are not produced within the geographical

area. Whether there is a larger demand market for e-learning products compared to a supplier's market appears to depend greatly on a nation's level of expertise in the use of e-learning technologies (Bashar and Khan, 2007). Countries such as Singapore are able to supply e-learning technologies and services to other countries within the region. Developing countries, on the other hand, are plagued by a digital divide issue and poor educational systems which greatly affect their ability to compete (Kyem, P.K. and LeMaire, P.K.,2006). E-learning may provide a way for them to leapfrog educational and developmental barriers (Davison, R., Vogel, D., Harris, R. and Jones, N., 2000).

E-learning is defined as "the delivery of training content via all electronic media, including the internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV and CD-ROM" (Urdan & Weggen,2000, p.8, pp.2). At the national level, e-learning implementations may be referred to as a coordinated effort by the government to introduce ICT into education at various levels within the society in an effort to achieve some clearly defined outcomes (Asia e-Learning Network, 2002b; Bashar and Khan, 2007; Bates, 2001; Charlton-Laing and Grant, 2008; Kearns, 2002; Rahman, 2004; Suktrisul, 2004). There are various strategies utilized by governments to incorporate ICT in learning. For example, Singapore formulated several consecutive Master IT plans designed to deal with the implementation of infrastructure in all schools, the training of teachers in the integration of technology in pedagogy and the provision of human technical support at schools (Bashar and Khan, 2007; Chew, 2006). Farrell & Isaacs (2007), after examining the use of ICT and Education in 53 African countries concluded that the majority of these countries had a national ICT policy. However, there was a great deal of variance among the policies relating to the use of ICT in education. Higgins (2002), in a review of the efforts of some European countries, also pointed to the various methodologies used such as the establishment of a national virtual university or the use of a comprehensive national approach to the problem.

There are varying amounts and characteristics of the resources within learning environments. If the input does not have the characteristics that would make it immediately usable, it has to be

converted to an asset, an input that will enhance the chances of achieving the desired outcome. Markus and Soh (1993) posited that assets result from the application of conversion processes on inputs. The efficiency of the conversion depends to a large extent on the ability to provide a plan of action for transforming infrastructure inputs, to manage the process and to configure inputs to create assets (Markus and Soh, 1993; Weill, 1992). The process of training teachers, instituting educational reform activities, training of technology support staff, training students, implementing technological resources and converting existing content to digital formats, are all activities identified in the literature that would transform or convert resources into assets (Crichton and Labonte, 2003; Jones, 2004). These activities could constitute specific capabilities that have the role of making the resources more useful or valuable. Brown (2000) emphasizes the importance of investigating the capabilities needed for an e-learning implementation to facilitate a greater understanding of the process. The nature of these capabilities, the learning and unlearning occurring in their execution, the skill building process and the established routines in the manipulation of the resources would be valuable information for providing structure to the national e-learning activity. This research seeks to provide an answer to the question: what capabilities are necessary to execute a national e-learning implementation. It utilizes a dynamic capabilities framework to provide greater understanding of some of the basic actions needed to prepare the inputs into an e-learning implementation to increase the chances of increased outcome from the implementation. Three capabilities are identified through examining the activities of the major stakeholders in a national e-learning project in a developing country, Jamaica.

2. Problem Definition

Although e-learning implementations have been entered into at various levels, there is the possibility of achieving more widespread benefits if this is undertaken at the national level. Governments can provide a centrally coordinated implementation effort that is aligned with specific national goals for educational reform and the development of technical competency (Bates, 2001). Kearns (2002, p.21) postulates that the need for a government approach to e-learning implementations has arisen because policy for ICT use in education is now seen within

"the context of broader social and economic objectives, such as building a connected learning society and responding to the economic objectives, including learning and skill requirements of the knowledge economy". However, there are mixed results amongst countries that deploy e-learning at the national level (Bashar and Khan, 2007; Kearns, 2002; Minges, Ismail and Press, 2001; Pagram and Pagram, 2006; Trinidad, 2002). For example, Singapore's e-learning initiative has contributed to producing a skilled workforce and significant economic growth due to increased revenue from e-learning. As a country, they have developed expertise in this area and as a result are able to supply e-learning services to other countries (Bashar and Khan, 2007). The Malaysian government has implemented many programs to boost the e-learning industry in that country (Alhabshi, 2002; Rahman, 2004). These have led to improved results in the higher educational institutions but with less success in the primary and secondary schools. On the converse, there are other countries which have experienced minimal effect from e-learning. A national e-learning initiative in the Philippines has resulted in only a slight improvement in literacy levels (Trinidad, 2002). Many universities in Africa have been implementing strategies to be globally competitive in education. However, the extensive digital divide acts as a barrier to the success of such initiatives (Nelson, 2001). The variation in the outcome of the implementation could be an indication that there is insufficient knowledge of how to carry out these implementations (Gilbert, 2000).

3. Theoretical Underpinnings

This research utilizes dynamic capabilities theory. The dynamic capabilities perspective, according to Teece, Pisano and Shuen (1997), relates to the ability of an organization to find new ways to achieve competitive advantage by readjusting to keep up with the changing business environment. Eisenhardt and Martin (2000, p. 1107) defined dynamic capabilities as processes that "use resources to integrate, reconfigure, gain, and release resources". Dynamic capabilities can consist of other capabilities, each with its respective routines. These are the routines that firms use to create new resource configurations to achieve some competitive advantage. Dynamic capabilities are often imitable and hence cannot lead to long-term competitive advantage. However, the advantage is in the dynamism of the competency building process, the

learning and unlearning process that occurs and the readjustment of internal and external competencies. These will enable an organization to take advantage of a market opportunity before another entity does. In developing capabilities, the temporal order or sequencing of activities is critical (Brown and Eisenhardt, 1997). However, the evolution of dynamic capabilities to create increased outcome can actually be developed through multiple learning paths. Hence, entities with differing resource configurations can achieve the desired outcome depending on how they configure the resources that they presently have.

4. National E-learning Implementation Framework

Charlton-Laing and Grant (2008) presented a framework linking investments in e-learning at the national level to outcomes (see Figure 1). This framework consisted of four constructs and three intermediate processes that influenced the gradual development of infrastructure to assets to the realization of impacts and finally to the achievement of outcome. Charlton-Laing and Grant (2008) explained that e-learning infrastructure is a pre-requisite for the creation of e-learning assets. E-learning infrastructure can be divided into IT physical capital, IT human capital, non-IT physical and non-IT human capital resources (Barney, 1991; Melville, Kraemer, and Gurbaxani, 2004; Ross et al, 1996). This construct they further articulated consists of the infrastructure present in the schools before an e-learning implementation and in additional those new investments that are needed such as new equipment, networks and learning management systems. E-learning assets result from the application of e-learning capabilities on e-learning infrastructure. E-learning assets can also be divided into three categories: technology, human and learning content. Table 1 provides a greater understanding of the various assets. E-learning capabilities were defined as those higher-order management skills that configure infrastructure to create assets (Soh and Markus, 1995). Several e-learning capabilities were proposed: - IT infrastructure, educational transformation, institutional support, learning content creation, relational and e-learning research.

Table 1. Explanation of the E-learning Asset Construct (Charlton-Laing and Grant, 2008)	
E-learning Asset	**Definition**
Human assets	Skills and knowledge possessed by the teachers, students, equipment maintenance staff and training content developers
Technology assets	IT equipment, connection technologies, technology platforms and internet infrastructure
Learning content assets	Content that is represented in a digital format to effectively deliver pedagogy

In this research we are concerned with the e-learning capabilities affecting the relationship between e-learning infrastructure and e-learning assets.

Figure 1. A Framework for National E-learning Implementations (Charlton-Laing and Grant, 2008)
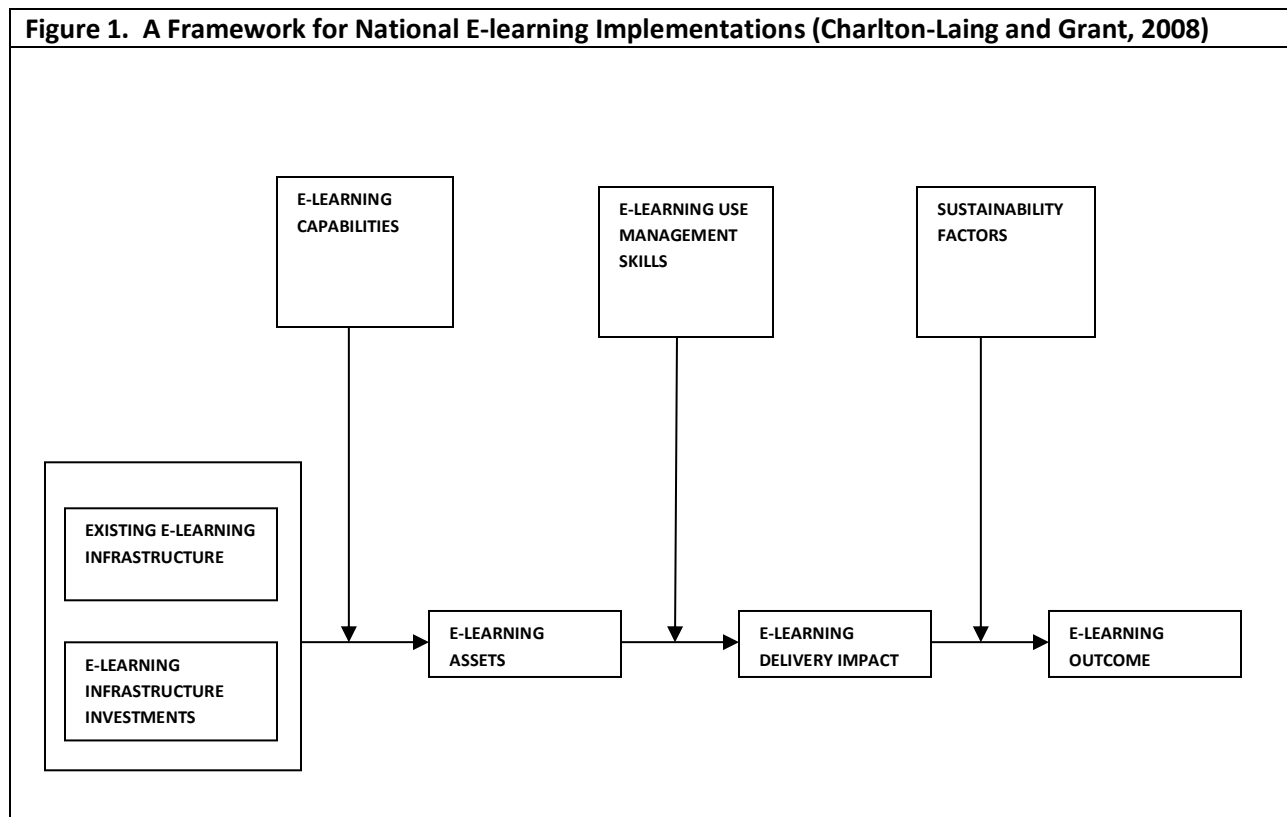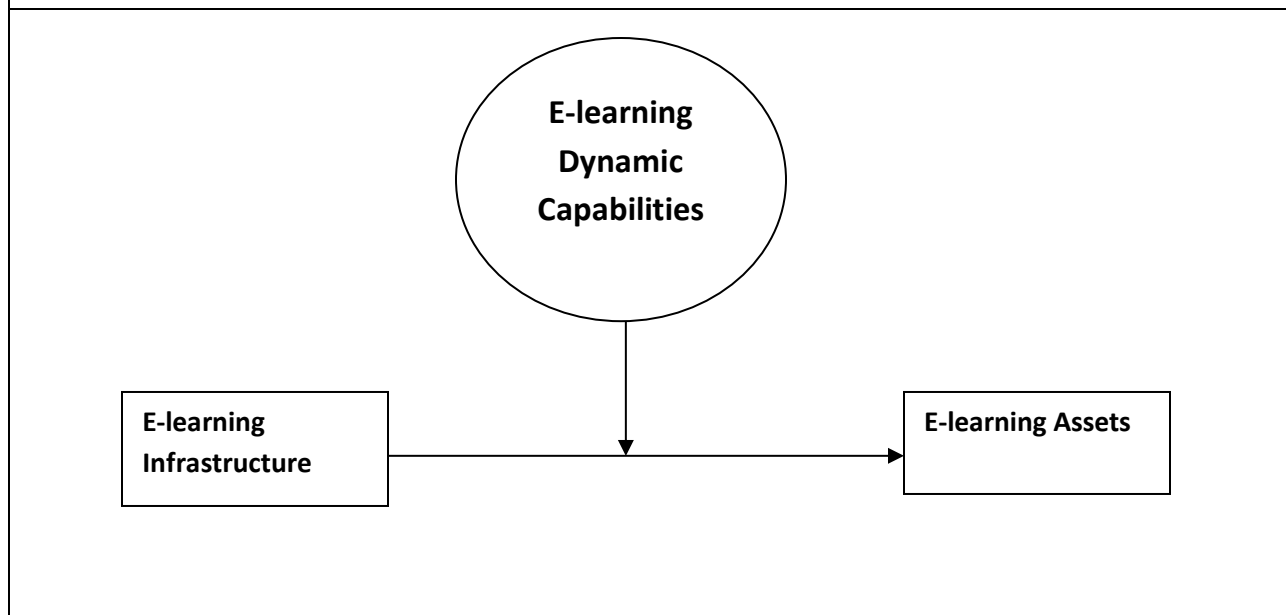
5. Research Model

The aim was to provide a listing of the most prominent capabilities emerging from the data along with a brief description of some characteristics of these capabilities. Thus measurement items were derived for the capabilities that resulted in the creation of the three assets proposed by Charlton-Laing and Grant (2008), (see Table 2). The research question was answered by the identification of the capabilities emerging from the data collected.

Table 2. Relationship between E-learning Infrastructure, E-learning Capabilities and E-learning Assets		
E-learning Infrastructure	**E-learning Capabilities**	**E-learning Assets**
IT Physical	IT Infrastructure	Technology Asset
IT Human, Non-IT Human (student, teacher, principal, systems administrators, content developers)	Human Capital Development	Human Asset
Non-IT Physical (Learning Content)	Learning Content Creation	Learning Content Asset

Figure 2 presents the research model.

Figure 2. Research Model

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                    ┌─────────────┐
                    │  E-learning │
                    │   Dynamic   │
                    │Capabilities │
                    └──────┬──────┘
                           │
                           ▼
┌──────────────┐                    ┌──────────────┐
│  E-learning  │                    │  E-learning  │
│Infrastructure│───────────────────▶│    Assets    │
└──────────────┘                    └──────────────┘
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IT Infrastructure Capability

IT infrastructure capability is the enabling base of shared IT capabilities providing the foundation for business systems (McKay and Brockway, 1989; Weill, 1992; Weill and Broadbent, 2000). IT infrastructure capabilities are constantly evolving and expertise is accumulated over time (Duncan, 1995). They are tacit and are embedded in routines and processes. In addition, this capability may not reside with any one individual or company but could be shared amongst person within an organization or across organizations (Grant and Chen, 2004). Lall (2001) identified linkages as an important aspect of technical capabilities as capabilities cannot be developed in isolation. Forming and maintaining these networks is necessary as the e-learning organization cannot produce all the expertise to handle every aspect of the project. It can bolster its IT infrastructure capability by entering into meaningful partnerships with other providers.

The effective use of e-learning necessitates having adequate technological infrastructure in place (Bashar and Khan, 2007). This technological infrastructure refers to the availability of desktops

or laptops, wide access and low-cost telecommunications infrastructure, communication and connectivity. Internet access, audio visual equipment, computers and other media are all essential aspects to the infrastructure needed to facilitate an e-learning initiative. A robust technology infrastructure is needed to connect students, learners and administrators. There should be connectivity between all educational centers.

Human Capital Development Capability

Human capital development capability is the ability to analyze and coordinate an ongoing training or developmental plan for the human elements of the project. Through the execution of the human capital development capability there was the preparation of the principals, teachers and technical support persons to work with and/or support the technology platform. This capability was successful in part in the preparation of persons to be good receivers of the technology. Tables 3-6 show the characteristics of the human element within the project.

Table 3 Measurement of the Characteristics of The Student	
Measurement Item	**Reference**
Students are digitally fluent.	Resnick (2002)
Students are able to learn independently.	Resnick (2002)
Ability to analyze and integrate information from separate sources to solve a complex problem.	Stein, Haynes and Unterstein (2003)
Good communication skills (reading/writing/speaking/listening).	Bates (2001)
Students are motivated.	Selim (2007)

Table 4 Measurement of The Characteristics of Teachers	
Measurement Item	**Reference**
Highly motivated	Kushner, Carey, Dedrick, Wallace (1995)
Empowered	Bennett, Priest & Macpherson (1999)
Possess technical expertise	Tan, Hu, Wong and Wettasinghe (2003); Yun and Murad (2006)
Able to integrate technology in the delivery of pedagogy	Kent and McNergney (1999); Tan, Hu, Wong and Wettasinghe (2003); Samuel and Zaitun (2007)

Table 5 Measurement of the Characteristics of The Principal	
Measurement Item	**Reference**
Possession of instructional and technical competency	Agboola (2006)
Exhibits Technology Leadership	Agboola (2006); Anderson & Dexter (2000); Ertmer, Bai, Dong,Khalil,Park and Wang (2002) ; Law,Pelgrum, & Plomp (2008); Crystal (2001); Schmelzer (2001); Stegall (1998); Wiboonuppatum (2006)
Allocation of funding for e-learning	Bates (2001)
Provide incentives for teacher performance	Wiboonuppatum (2006)
Professional Development Plan for academic staff	(Cheng & Cheung, 1999); Macneil and Delafield (1998); Wiboonuppatum (2006)

Table 5 Measurement of the Characteristics of The Principal	
Measurement Item	**Reference**
Provision of adequate technological infrastructure	Macneil and Delafield (1998)

Table 6 Measurement of IT Human Asset	
Measurement Item	**Reference**
IT Human resources have adequate skills for the job.	Chapnick (2000); Borotis & Poulymenakou (2004); Kaur & Abas (2004); Haney (2002); and Aydin & Tasci (2005)
Sufficient human resources are available to satisfy needs.	Unesco Bangkok (2004)
IT human skills are productive.	Ross, Beath, and Goodhue (1996)
The educational objectives of the project are understood.	Ross, Beath, and Goodhue (1996); Zhao, Pugh, Sheldon and Byers (2002)
IT staff has strong interpersonal skills that help them in training and supporting users.	Ross, Beath, and Goodhue (1996); Sumner (2000); Byrd and Turner (2001)

Learning Content Creation Capability

Learning content creation capability is the skill needed to acquire digital learning content while ensuring a tight fit between the content and the curriculum and the appropriate representation of teaching concepts with technology. It is a challenge to produce pedagogically coherent learning content for an individual learner's needs and preferences (Turker, Gorgun and Conlan, 2006).

One such challenge is ensuring that content has the culture of the society in which it will be used embedded in it (Pagram and Pagram, 2006). Another is the creation of the digitized content itself. If current learning materials are in paper form, they need to be converted into digital form. This is not a straightforward transformation. Content creation should conform to standards for e-learning content and systems development such as SCORM (Sharable Content Object Reference Model). If content creation adheres to this standard then this may result in the ability to mix and match content without worrying about technical incompatibilities.

6. Case Study

The unit of analysis in this study is E-Learning Jamaica Limited. The Ministry of Energy, Mining and Technology in Jamaica, established E-leaning Jamaica as a limited liability company to implement the various components of the national e-learning project to improve the quality of education in schools (see Table 7). In the national e-learning project, technology was used to enhance the educational experience. The project had five components which addressed five of the issues previously identified in the Jamaican school system.

Table. 7 Constraints in Education System and The E-learning project component designed to address them (Feasibility Study for E-learning Project, April 2005, p.5-6)	
Constraint	**Project Component**
"Lack of a comprehensive set of standard instructional materials for both teachers and students."	"Development of a detailed and comprehensive set of digital instructional materials for teachers and students in eleven (11) designated subjects spanning grades 7-11."
"Inadequate equipment in schools to enhance teaching and learning using modern technologies; lack of a proper	"Provision of two computer labs in each school for teaching of all eleven subjects."

Table. 7 Constraints in Education System and The E-learning project component designed to address them (Feasibility Study for E-learning Project, April 2005, p.5-6)	
Educational Management Information system in the MOEYC to facilitate effective administration of the education sector"	"Approximately 100 public libraries would also be equipped with computers and connected to the Internet. "
	"Support would be provided for an Educational Management Information System (EMIS) of the MOEYC to enable the Ministry to properly administer the education sector. "
	"Eleven (11) cable television channels would be dedicated to the transmission of the lecture series."
"Low level of skills among some teachers in the use of certain technologies."	"Teachers would be trained in the instructional materials, computer applications, interactive software and multimedia skills."
"Inadequate remedial programme at Grade 7."	"Institute an extensive remedial programme based on voluntary inputs and the use of interactive software."
"Lack of a standard system of assessing performance at each grade for students, teachers and schools"	"Institute on a voluntary and phased basis a standard end-of-year Pre-CXC Examination in the eleven (11) subjects to measure school performance and assess project achievement."

The Jamaican e-learning project was originally slated to be implemented in two phases. The research phase would be the testing ground for the project design, approach to implementation, the use of teaching and learning materials, the technology applications and software as well as the support systems that must be in place. The pilot phase would inform the rest of the implementation.

7. Research Methodology

In an effort to provide a better understanding of national e-learning implementations, a qualitative research method was employed, utilizing a case study design approach (Eisenhardt, 1989; Yin, 1994; Yin, 2003).   The case research strategy, according to Eisenhardt (1989), focuses on understanding the dynamics present within a particular setting. The research design comprised a single case study of a national e-learning implementation with embedded cases. Each school examined within the case study, the e-learning implementation in Jamaica, was regarded as a case by itself. The managing entity, E-Learning Jamaica Limited, had to form linkages with vendors, service providers, government entities, educational institutions and teacher training institutions in order to execute the project. As a result, information was gathered about one or more of these entities as seen necessary to sufficiently explore the research question.

Various data collection methods were employed so that there was triangulation of evidence. Information from unstructured interviews with personnel at E-Learning Jamaica Limited was used initially to refine the model. Thereafter structured interviews using interview themes based on the literature and information gathered from unstructured interviews were conducted. Secondary data, drawn from policy documents, reports, and other published sources, were collected over a period of 5 years.

Purposeful sampling was employed in the choice of schools and interviewees in the schools. The 18 public schools were chosen using various criteria – rural vs. urban, traditional vs. non-traditional and to a lesser extent the parish in which the school was situated. The rural vs. urban segmentation was used to determine if the implementation differed between the town and country areas since resource problems may plague schools within the rural areas compared with those in the metropolitan area.   The traditional vs. non-traditional (newly upgraded schools) segmentation was used because of the perceived educational standard gap between schools in

these categories. The choice of schools from each category helped in the investigation of whether this educational standard gap influenced the effect that the project had on the school. The final criterion used in the selection of schools was the parish segmentation. Although Jamaica has 14 parishes, data was gathered from 4 parishes – Kingston, St. Catherine, Clarendon and St. James. These parishes were chosen because of their proximity or distance in relation to E-Learning Jamaica Limited. E-Learning Jamaica Limited is located in Kingston. St. Catherine is a parish in close proximity to Kingston. The parish of Clarendon is a further distance from Kingston than St. Catherine, while St. James is located on the opposite side of the island. The interviewees were chosen based on their involvement in the e-learning project. In total 180 interviews were conducted.

Interviews were recorded using a digital recording device and were transcribed verbatim with F4, free transcription software. The data was uploaded into Nvivo 8.0 and analysed to see if there were significant processes that manipulated the e-learning inputs.

8. Findings and Discussion

Three dynamic capabilities were derived within the analysis. These include IT infrastructure capability (Bashar and Khan, 2007; Grant and Chen, 2004; McKay and Brockway, 1989), human capital development capability (Evans and Bellet, 2006; Goodyear, Salmon, Spector, Steeples, and Tickner, 2001; Jones, 2004; Tan, Hu, Wong and Wettasinghe, 2003; Trinidad, 2002; Zahran, 2003) and learning content development capability (Pagram and Pagram, 2006; Zahran, 2003).

IT Infrastructure Capability

Based on the data that was gathered, the IT infrastructure capability integrated the new and existing technology in order to provide an appropriate and available technology infrastructure for the schools to use. It connected technical infrastructure, legacy and new, physically throughout all the schools, public buildings such as libraries and with the Ministry of Education. The

physical connectivity within schools was achieved so schools that did not have a network before were provided with one. There was connectivity to a central repository for educational materials which provided access to many learning resources. High quality technical resources were also provided. A technical support structure spanning all the entities in the project was created to ensure that the equipment was maintained, hence usable. Regular reports were provided by schools to E-Learning Jamaica Limited and there were regular meetings between Systems Administrator and E-Learning Jamaica Limited to discuss issues. There was also the use of established technical support mechanisms such as resources available on the E-Learning Jamaica Limited website. Through the IT Infrastructure capability there was an attempt to integrate the school's culture in the technical implementation through the school's technology plan. However, this was not as effective as hoped for as it did not ensure that the school's policies and procedures facilitated the use of the technology by the students.

Human Capital Development Capability

Students

Students (learners) should be the central focus of the e-learning initiative. However there was no preparation of the student to ensure maximum benefit from the initiative. The focus was mainly on training and increasing the awareness level of teachers, system administrators and principals. Generally, the students were technically competent and were motivated to use the new technology. They possessed technical skills from various sources. Since e-learning facilitated students learning through access to a diversity of resources, the ability to self-teach was also important. This existed among students to a limited extent. It was necessary for the teachers to supervise this process and also provide guidance on how to select appropriate information from the internet. There were other skills, namely communication and comprehension, which was deficient among the students in some of the schools.

Teachers

Much more attention was given to the preparation of the teachers than was given to the students. A needs analysis was conducted to determine the levels of technical knowledge of the teachers

and therefore the training that would be necessary. Local providers were appointed to do the training so there was the development of local training expertise. Localized and centralized training modes were used to educate the teachers. There were issues with the coordination of the training hence E-Learning Jamaica Limited devised a scheme whereby they would train individual(s) from a school and they would in turn go back and organize training at that school at the convenience of the staff. Trainers developed additional expertise. An International Best Practice Training Format was used with training consisting of basic ICT training, advanced ICT skills and the integration of ICT into pedagogy, system administrator training and train the trainer training.

It appeared that a customized training effort may have been necessary as the older academic staff were not interested in e-learning. There were mixed reactions about the training being redundant for persons with prior technical expertise and also not being sufficient for persons with very little technical expertise. The more advanced technical training may have included participants that had formal technical training and those that did not. This uneven pairing of teachers may have frustrated the more experienced participants. Professional development for teachers should be aimed at the appropriate stage that the teacher is at so that it can extend their skill base (Lai, 1999). Persons should have been grouped according to specific abilities as some teachers were frustrated with the training.

To be most effective a teacher's role should change from one of teacher to facilitator of the learning process (Lai, 1999). Teachers were no longer regarded as imparters of knowledge. This could be a significant role shift for a teacher, one requiring significant preparation. Teachers needed to understand that the technology was a tool to enable them to get closer to their students and be able to impart to them more effectively. Teacher should be able to utilize teaching tools in such a way that they maintained control of their classroom (Kelly, 2007). The data collected did not necessarily indicate the level of control that the teachers felt with the introduction of e-learning but it certainly pointed to a lack of understanding of the purpose of the initiative. Marsh (1993) indicated that in an implementation of this type teachers may feel threatened by

technology. It was felt in some cases that the implementation would lead to the need for fewer teachers in schools. Also, some teachers felt that e-learning increased their workload while for others they believed it was lessened significantly. Therefore a significant weakness of the e-learning project was that there was not sufficient awareness of the transformation that should occur in the way a teacher operated. The teachers that regarded themselves as facilitators of learning since the implementation may have regarded themselves as having that role prior to the implementation.

Principals

The human capital development capability should assist with the development of principals by creating technical expertise and leadership and inspiring interest and ownership of the project. This may be demonstrated by principals finding creating ways to fund aspects of the e-learning project and make it sustainable within their school.

The participation of the principals in the e-learning project was limited. There were principal awareness and orientation sessions. Yet there was evidence that principals did not fully understand their role. Some principals believed that their role was one of a facilitator [not participant] of the use of technology while others did not have full knowledge of all equipment placed in the school for the purpose of the project. A principal who was enthusiast about technology could generate this enthusiasm in the rest of the staff. Principals were enthusiastic about getting the technology in the schools to the extent that, despite restricted budgets, they funded building construction and repairs in the schools to ensure that the facilities were in a state of readiness to receive the technology. Perhaps it appeared empowering for the school to possess the new infrastructure.

There were a few principals who appeared to place emphasis on technology prior to the e-learning implementation. This was evidenced by the hiring of dedicated systems administrators and the provision of extensive computer facilities. E-Learning Jamaica Limited tried to build technical capacity by ensuring that principals created a technology plan. However there did not appear to be a clear vision for technology in all schools. Although the principals were motivated and eager for the technology in the schools most of them did not participate in the entire training.

Training should have been mandatory for all principals. Principals should be well immersed in the training provided; so much that they themselves can in turn train the teachers (Weiss, 1994).

Macneil and Delafield (pg. 296) suggested that principals needed to "understand the importance of technology for improving school management as well as its implications for improved instructions". Principals should not only appreciate technology's use in education but should be aware of its great potential to the point that they can motivate teachers to use it. According to research conducted by Stegall (1998), one of the single most determinant of success is an energetic and enthusiastic principal. As further articulated by Stegall (1998, pg.9), the principal should show a willingness to support their conviction in various ways including "allocation of resources, hiring of technology personnel, scheduling of classes for students and staff development for teachers". The literature has proposed top-leadership commitment as one of the antecedents for the creation of absorptive capacity (Lundvall, 1992).

Infrastructure support personnel

Bates (2001) identified four levels of human support needed to ensure the functionality of e-learning technology. This research focuses only on one of these, the role of the technology support staff as the most widespread infrastructure support personnel throughout the schools. There was a formal training component included in the e-learning project for the systems administrators. The role of the technology infrastructure support staff would be to ensure that the networks and equipment are properly installed, operated and maintained. There should also be a plan for continual maintenance of the equipment. This is very important as unreliable equipment can create confusion among teachers who are not fully familiar with trouble-shooting technology and may eventually make them revert to the traditional forms of delivery.

E-Learning Jamaica Limited created an enabling support architecture which included the creation of trained system administrators in schools and resources for trouble-shooting and access to vendor support. Technical support was critical in the schools to ensure that the technology is usable. The majority of teachers were not technically proficient and this would put pressure on the support infrastructure. To compound the issue, there were limited IT Human

Resources in most schools as the government did not provide for such a position in the schools. There were two variants of this system administrator role, a teacher doubling as a system administrator and a dedicated system administrator. A dedicated system administrator was paid by the school and not by the government. Few schools had dedicated systems administrators. Most system administrators had to retain the dual role of teacher and system administrator. The system administrators recognized that this impacted the students negatively.

A standardized training course was provided for all the system administrators throughout all the schools. This no doubt led to the increase of expertise of some of these persons. The standardized training and the standardization of equipment facilitated the mobility of technical skills and the sharing of technical expertise between schools.

There was a direct communication channel to E-Learning Jamaica Limited's support personnel for some technical issues. Others are channeled through the technology vendors. System administrators possessed good communication skills and were able to communicate effectively with teachers and students whether they were doubling as a teacher or were dedicated systems administrators. They are viewed as being helpful. However most systems administrators were overworked and frustrated. The role of systems administrator seemed to have been thrust upon them.

Learning Content Creation Capability

Learning content creation capability would be affected by the existence of high quality learning material, a standardized curriculum for all schools and access to teaching expertise of master teachers and subject experts. High quality written content was not present in all schools. However the project created digital content from the high quality teaching notes that existed. There was the development of a comprehensive set of standard instructional materials for use by both teachers and students. Digitized content was created in several ways through staged competitions, the digitization of existing learning content and the procurement of off-the shelf content. Digitized content was tightly fitted to the CXC/CSEC curriculum which was used throughout all the schools. Subject coordinators were employed to coordinate materials

development for specific subjects, provide guidance to various service providers, coordinate their efforts, review their work, provide timely feedback, adjust as necessary and be responsible for quality control. Quality control was further considered as a Hypermedia Consultant was employed to ensure the pedagogical integrity of the instructional materials acquired or developed, ensuring the adherence to international standards and best practices.

Content was not created on an ad-hoc basis. It was developed in a modular form. There were various forms of content:- TIMS (Teachers Instructional Manual), SIMS (student instructional manual), videos and interactive computer software. All the various forms of content tied in to each other to support the various themes. Efforts were made to incorporate the local culture into the digital content. All learning materials were stored in a central repository. This was designed not to be technically complex to avoid the costs of complex infrastructure and lots of IT infrastructure support personnel. The Ministry of Education held the copyright for all electronic educational materials. A standardized curriculum was in existence at the start of the project but the delivery varied within the schools. The capability pulled on the expertise of master teachers to create applicable content. The Learning Content Creation Capability resulted in the development of high quality, synchronized learning material applicable to all the schools, traditional or non-traditional.

9. Conclusion

Three necessary conversion capabilities, IT infrastructure, human capital development and learning content creation are proposed that convert inputs into an e-learning installation. These provide a greater understanding of the processes needed to increase the chances of having a successful implementation. They do not represent all of the capabilities necessary for a successful e-learning implementation as other capabilities are proposed (Charlton-Laing and Grant, 2008). However, these can be examined in future research efforts.

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