How Can Schools Ensure That Technology Really Benefits Students?

Dr. Benita Thompson
Mrs. Andrea Burnett

UWI Education Evaluation Centre

Technology is all pervasive in our 21st century world; whether driving a car, sending an e-mail, using a cellular phone or simply shopping in the supermarket. It therefore stands to reason that if our education system is preparing our students for the 21st Century world then technology must be central to what is taught in our schools. In light of this, schools must ensure that technology is not only accessible but that the use of technology actually benefits their students.

The central thesis of this paper is that technology can only truly benefit the majority of students if it permeates the entire school; in student instruction and assessment, school administration and teacher professional development. Firstly, to articulate this position, the term 'technology' will be delineated and the benefits to schools outlined. Secondly the paper will focus on issues which schools should consider as mechanisms to facilitate student achievement through the use of technology. These include but are not limited to technology integration, teachers' professional development, student assessment, the principal as technology leader and technology's use in school administration.

What is Technology?

The United Nations Education, Social and Cultural Organisation, (UNESCO), defines technology as: "...the know-how and creative processes that may assist people to utilise tools, resources and systems to solve problems and to enhance control over the natural and man-made environment in an endeavour to improve the human condition," (UNESCO,1985). Similarly, the International Technology Education Association (ITEA) describes technology as, "how people modify the natural world to suit their own purposes... generally it refers to the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants." (Excerpt from *Standards for Technological Literacy: Content for the Study of Technology*, ITEA,

2000). For the purpose of this presentation, however, technology refers to teacher and student use of computers and other electronic technologies to enhance the teaching-learning environment thereby facilitating such skills as creativity, problem solving, critical thinking, and cooperative learning among others.

How Can Technology Benefit Our Students?

The literature is replete with myriad examples of the value of technology to student learning. The North Regional Educational Laboratory (2005) cites studies by Cavanaugh (2001), Gordon & Means (2000), Fergusson & Cavis (2001) and Wenglinksey (1998) who attribute the use of technology to student achievement. These studies purport that computer based instruction, technology rich environments, access to wireless laptop computers and simulation and software that teach higher order skills, all result in positive gains on both standardized and national tests (p.6). Conversely, a number of studies point to the fact that all gains are not derived in test scores but rather in student competencies necessary for the 21st Century world.

Morgrath (2002) outlines and explains how students can benefit from technology:

1. Technology increases student motivation, and motivated students are more receptive, more engaged, and more likely to learn.
2. Technology promotes cooperation and collaboration among students and good teachers can capitalize on these opportunities. Cooperative learning approaches with technology give students with different talents a chance to excel.
3. In classrooms with computers, conversations between teachers and students and among students themselves become deeper and more probing.
4. With technological tools, students show more persistence in solving problems.
5. Technology encourages varied methods of assessment.
6. Technology fosters increased and improved oral and written communication.
7. Technology enables opportunities for more depth of understanding, but the breadth of the curriculum is still problematic.

8. Technology provides increased opportunities for thematic, interdisciplinary explorations; teachers can use these interdisciplinary connections to further engage and excite students.

9. Technology makes classroom activities "feel" more real-world and relevant, and students often take these activities more seriously**.**

Given the positive impact of technology use on student achievement as outlined by Morgrath (2002) and its capacity to instill higher order skills, teachers should ensure that their students benefit from meaningful and appropriate technology integration practices.

Technology Integration

Technology integration is the effective use of technology by students and teachers to support the teaching-learning process. Teachers integrate technology for the purpose of introducing, reinforcing, extending, assessing and remediating curricular targets. Moreover, Antifaiff (2002), reports that "Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally" (p.3).

In Barbados as in other parts of the world classroom technology use has not kept pace with technology utilization. Bauer and Kenton (2005) are of the opinion that even though tremendous amounts of money has been spent on hardware and software yet "...students still spend most of the school day as if these tools and information resources had never been invented" (p.520). While this statement might appear to be quite harsh and does not necessarily apply to the entire school system or all classrooms, it may nevertheless paint a true picture of some classrooms in schools with technology.

The study conducted by the Education Evaluation Centre (2007), "Teachers' Perceptions and Practices relating to the Reform Curriculum and the use of Information Technology Communications," found that one-third of the 366 teachers surveyed, frequently engaged in five of sixteen technology integrated activities, whereas more than half never or rarely

engaged in six of the sixteen activities (p.27). Given the benefits which can be derived from technology use, it is important to discover why teachers find it difficult to integrate technology into their everyday teaching practices and offer solutions which will facilitate greater integration of technology.

The results of a qualitative study conducted by Bauer and Kenton (2005) in the United States of America on the classroom practices of teachers, suggested that teachers' reluctance to use technology in their teaching resulted from the fact that integration of computer technology into the curriculum was poorly planned. They further contend that teachers were poorly trained, did not understand the role technology could play in the teaching-learning process and generally felt threatened. While these may be genuine factors for teachers in the USA and may also apply to Barbadian teachers, a number of other factors were outlined by 366 primary and secondary Barbadian teachers who identified barriers to technology use.

The UWI Education Evaluation Centre's (2007) study on "Teachers' Perceptions and Practices relating to the Reform Curriculum and the use of Information Technology Communications," sought to ascertain factors which impacted on teachers' use of technology. Of the sixteen factors, four were identified as having the most impact given their relatively high mean scores. These included: '*lack of release time to practice technology' (2.78); lack of release time to plan for technology use (2.76); inadequate time to plan technology lessons (2.64) and lack of good instructional software (2.61)* (p.20). From these results it is evident that time constraint in relation to planning for technology use is a key issue. The results of factor analysis also revealed that factors related to 'technology support' and 'limited resources' also impacted on teachers' use of technology.

In light of the factors mentioned as causes of limited technology use it is imperative that schools devise measures to tackle these issues to ensure that students really benefit from technology. As suggested by Baurer and Kenton (2005), technology integration into the curriculum must be clearly planned. Moreover, technology should not be used haphazardly but should complement existing learning objectives.

One means of ensuring that technology becomes part and parcel of everyday instruction is through unit planning which incorporates technology in a manner which supports the existing objectives of the curricula. When developing unit plans various aspects of technology related to specific lesson objectives should be included. These activities may involve accessing the internet, using a specific software application to enhance a skill, or the development of an end product such as a student-created power point presentation. The emphasis on student created end products is significant as students need to be involved in active learning.

Unit Planning

Effective technology integration calls for planning and teachers should be guided by the goals and objectives of the various subject content areas. An effective method of achieving such infusion is for teachers to delineate both educational and technology goals in their unit plans. For example, in preparing a unit plan on the topic 'number sense', both technology and mathematics objectives should constitute the student learning objectives as illustrated in Table 1.

Table 1: Mathematics and Technology Objectives for a Unit Plan on Number Sense

Mathematics Objectives	- Demonstrate one to one correspondence of a set of pictures/ objects. - Count sets of objects. - Find sums and differences to 5 through the use of manipulatives or real objects
Technology Objectives	- Use input/output devices (keyboard, mouse, and printer). - Use draw and paint applications (KidPix). - Use electronic resources to practice skills and remediate deficits.

In addition to the inclusion of technology objectives there should also be evidence of technology integration throughout the unit plan as outlined in Table 2.

Table 2: Evidence of Technology Integration in a Unit Plan on Number Sense

Pre-requisite Skills	Basic knowledge of computer mouse and ability to access (KidPix)
Instructional Strategies	Teacher will model the use of KidPix to create representations of a specific number
Unit Scope and Sequence	Technical use of KidPix to develop number sense
Student Assessment	An assessment tool will be used to evaluate student technology skills as demonstrated through three unit activities

The examples in Tables 1and 2 outline how technology can apply directly to the content areas taught in the classroom and represent how the technology is driven by teaching rather than the teaching being driven by technology.

Schools can also ensure that students benefit from technology if teachers identify the places where technology can effectively and appropriately support their learning goals. To help teachers think strategically about the best ways to use technology, they should be aware of the various technologies and the specific purposes they serve. Table 3 outlines the specific purposes of various types of technology.

Table 3: Instructional Purposes behind the Use of Technology

Instructional Purpose	**Examples of Hardware/ Software**	**Examples of Classroom Use**
Gain access to information	Internet	Research on topics
	Digital microscope	Collecting data
	Handheld computers with probes	Collecting data for science experiments
	Databases	Locating information
Make sense of information	Graphic organizer software	Brainstorming, organizing information, planning, writing, categorizing and classifying information in stories
	Spreadsheets	Analyzing numbers, graphical representation
	Databases	Sorting and analyzing information

Table 3: Instructional Purposes behind the Use of Technology Cont'd

Instructional Purpose	Examples of Hardware/ Software	Examples of Classroom Use
Present and share information	Word processing	Reports, stories, class news-papers, literary
	Multimedia presentation	Reports, present results of research, experiments, etc
	Digital cameras and video	Reports/stories with a visual component
	Web page design	Communicating with a broader audience
Communicate with others	E-mail/ Discussion Boards	Communicating with people around the world

Source: http://www.scribd.com/do/4657466/Technology-Integration-at-SCIS

As suggested by Dias and Atkinson (2001), good teaching combined with appropriate and effective uses of technology makes for a dynamic, rich learning environment. In respect to the learning environments and technology integration, Dias and Atkinson (2001) further propose that it should be constructivist; allowing students to engage in meaningful and useful activities through which learning is accomplished. Moreover they contend that there should be a pedagogical shift towards student-centred classrooms with more project-based activities and opportunities for collaboration and co-operation on life skills.

Project- Based Learning (PBL)

Another approach which can be used to assure that students truly benefit from technology is the project based approach. PBL when used successfully promotes team, conflict resolution and problem solving skills. Additionally, students are better able to articulate their learning and are given more opportunities to explore concepts and develop deeper understandings. PBL is not new to the Barbadian educational landscape as schools have for years employed project work as an educational technique. However, what needs to be addressed is whether schools have in fact engaged in authentic project-based learning or simply completed projects. Kathryn Burke (2007) points out that, "successful examples of PBL always include a powerful and driving question that engages the hearts and minds

of the students and teachers" (p.7). She further explained that the question "is big enough to allow scope for all students and to reach across different key learning areas" (p.7).

Another aspect of PBL which needs to be examined is the meaningful and appropriate infusion of technology. As noted by Burke (2007), "The real strength of technology and multimedia in PBL lies in its infusion with subject curriculum and its genuine use in the production process" (p.8). Various types of technology can be used quite seamlessly during project based-learning. For example, digital cameras, tape recorders, video cameras, word processors, spreadsheets, databases and other types of software such as Adobe PhotoShop and Computer Aided Design and Computer Assisted Manufacturing (CAD-CAM) can be used to perform myriad tasks and create records of student learning. The use of student created multimedia presentations also allows students to make their work more visible and meaningful.

The internet is another powerful technology tool which, when utilized efficiently and effectively assists students in gaining deeper understanding of specific content areas. As posited by Burke (2007), "The Internet provided students with access to virtual simulations and excursions, libraries, and remote physical locations for research which they would have been unable to gain a deeper understanding of their content" (p.5).

The aim of PBL is for real-life context and technology to meet and achieve outcomes in the curriculum through an inquiry-based approach. Technology as a part of PBL makes school more meaningful and provides for in-depth investigations of real-world topics. To ensure that students benefit from technology teachers must also have the necessary competencies and confidence to deliver the effective use of technology. This can only be accomplished if teachers are exposed to appropriate professional development.

Teacher Professional Development (TPD)

Mitchem et al. (2003), cites Sparks & Hirsh (2001), who indicated that "professional development has the power to change the culture of a school and inform educators of more effective methods of teaching" (p.397). They further suggested that through effective teacher professional development, students will be assisted in reaching the high

levels of achievement needed for success (p.398). A similar opinion was also expressed by Mitchem et al. (2003) who pointed out that, "Professional development of our educators is an important factor in the academic success of our students" (p.398). Furthermore, "teachers must be trained to create intellectually powerful and technology rich environments for students while maintaining sound pedagogical practices" (p.398). In short, the effective integration of technology in our classrooms is highly dependent on the quantity and quality of professional development which teachers receive.

Having established the need for and the importance of teacher professional development it is imperative that schools consider how they can implement an effective program of TPD. Sugar (2005) contends that the conventional one-day in-service technology workshops conducted during and after school are inadequate and recommends that workshops should concentrate on the long-term development of teachers (p.549). Sandholtz (2005) asserts that much of the technology training which teachers receive is somewhat limited to fundamental computer operations. It is therefore imperative that schools go beyond "computer literacy" and devise training programmes which focus on technology as a teaching tool and how it can be integrated across the curriculum (p. 350).

The literature highlights a number of TPD approaches and foremost among them are the more traditional and the situational approaches. The former approach as suggested by Swan et al. (2000) "is more instructionist and application driven" (p.171). Swan et al. (2002) highlight that research on the more traditional professional development approaches have proven not to be very effective and have little impact on the day-to-day integration of computing technologies into classroom teaching and learning (p.169). In fact Swan et al. (2002) suggest that the failure of the traditional instructional approach is due in part to the fact that it is not situated in authentic classroom practice.

In contrast, the situational development approaches are more constructive in focus and situated in authentic classroom practice. Sugar (2005) advocates the use of situated professional development and defines such an approach as one that "serves teachers' specific technology needs within the specific classroom environment" (p.550). To implement an effective situational professional development approach Sugar (2005)

proposes that schools should have technology coaches whose role should be to provide technology support and guidance. Sugar (2005) also cites Smith (2000) who explained that these coaches should adopt the role of reviewer, director, monitor, facilitator and evaluator. Sugar (2005) further outlines a number of duties for the technology coaches which include but are not limited to the following:

- Provide teachers technical support; teaching prerequisite skills for implementing specific technology applications.
- Provide necessary curricular support
- Instruct teachers about various technology applications (e.g., spreadsheets, PowerPoint, web page design, etc.).
- Provide immediate technical assistance
- Collaborate with and encourage teachers in the use of technology
- Instructional technologist; instructional design, needs analysis and media selection.

Within the Barbadian context one may argue that the Information Technology Coordinator (ITC) already assumes these roles. However, research indicates that much of the ITC's time is spent troubleshooting and resolving technical problems and less time is spent on supporting teachers and administration in effectively instructing students on using a variety of technologies. Moreover, ITC's are also expected to teach for a number of hours per week thereby limiting time spent with teachers as an instructional coach. Given the ITC's myriad and time consuming duties they might find it difficult to dedicate sufficient time to an effective coaching program. In light of this it may become necessary to redefine the role of the ITC or provide additional personnel to fulfill the role of technology coach.

Whatever the strategy adopted there are eight basic principles suggested by Sandholtz (2001) which schools can adopt to ensure that students benefit from technology. Of the eight principles, four are emphasized since they specifically relate to teacher instructional practices. These include teacher input into design, teacher choice, participant collaboration and a constructivist environment.

Firstly, there should be teacher input into design. Unlike the traditional teacher in-service sessions planned by administrators or outside experts, teachers should play an integral role in designing the specifics of their teacher development. Sandholtz (2001) strongly believes that including teachers in program design will indicate the value of their perspectives, promote the understanding that teachers are integral to determining the focus of their professional development and also foster ownership and commitment to their development programmes (p.353).

Secondly, there should be some measure of teachers' choice. Sandholtz (2001) is of the opinion that when teachers can exercise choice, the likelihood of professional development activities reaching the classroom is highly guaranteed (p.353). It must be emphasized however, that it is not the teachers' choice to refuse participation in technology development programmes but rather to choose which phase of the professional development program will benefit them.

Thirdly, participant collaboration through participant teams, teacher trainers and group reflection is recommended. In respect to participant teams, it is suggested that teachers receive training in groups of two to four. This will most likely ensure that teachers support and collaborate with their colleagues in the design of curriculum for their instructional practices. These teachers could also act as lead teachers in the training of other teachers. Sandholtz (2001) is of the opinion that teachers would more readily respond to their colleagues than to outside experts who they may view as being too far removed from their everyday classroom experiences (p.358).

The fourth principle involves the creation of a constructivist environment where teachers are exposed to hands-on experiences as they practice, explore and collaborate with peers on authentic learning tasks and engage in hands-on active learning as they engage in the integration of technology (ibid, 358). The constructivist environment allows teachers "a chance to practice and try new approaches in a non-threatening, supportive environment—a particularly vital element of learning to incorporate technology into classroom instruction" (p.359).

Given the importance of teacher development programmes to subsequent technology use it is imperative that schools gain a deeper understanding of what makes effective programs to ensure that students really benefit from technology.

Assessment

Another area which schools should consider when seeking to enhance students' use of technology is assessment. This includes but is not limited to software related assessment and assessment of the use of technology by students to present their tasks.

Software Related Assessment

It can be argued that the use of technology in the classroom has been limited primarily to the delivery of lessons through the presentation of information and to a lesser extent, the modelling of specific tasks. In fact, there is little research conducted on the use of technology and its relationship to assessment where assessment through the use of technology is seen as a critical component of the teaching-learning process. Indeed, several studies have been carried out to present findings on the impact of the use of technology in the classroom on student learning outcomes (McFarlane 2000, Jackson, 1989, Osmundson, 1999) in Harlen, W. and Deakin Crick, R (2002)). These impact studies focused largely on a summative assessment of students' performance utilizing the pre-test/post-test and the experimental and control group approaches to determine whether there was any significant difference in the students' performance as a result of the use of technology. They also compared the results of students who completed tests using the computer to those who used pen and paper. Heap et al (2004) alluded to the fact that as far as assessment is concerned ICT for the classroom is designed to be delivered at the end of teaching, such as with online quizzes.

However, the use of technology in the classroom should not be pigeon-holed into a category of delivery of a particular subject or as the final aspect of the teaching-learning process. Instead, in addition to such use, its utilization should be expanded to include determining whether the student is actually grasping certain concepts as well as a vehicle to assist those students who are underperforming. In other words, the use of technology could be used in the teaching and learning process to also carry out formative assessment

and thus identify students' weaknesses as teaching occurs. Thelwall (2000) considered the use of ICT as a necessary part of determining whether learning is taking place. He considered the use of ITC in formative assessment where there is the creation of an online item bank that acts as exercises to test the students at various stages. While this approach to formative assessment is most appropriate to higher education because the student takes the initiative of completing the exercises when they are prepared, it still has some merit to the school setting because the teacher can develop an item bank of exercises that students can complete in class following some discussion. This process allows the teacher to review the attempts at carrying out the exercises in a timely manner and to see what areas of the subject matter needs to be reinforced.

The issue of timely feedback is critical to formative assessment and thus computer-based exercises would be less time consuming than looking through students' scripts. For example, during classroom observations by the Education Evaluation Centre in Barbados, at one secondary school it was observed that in the area of document preparation such as letters, all the exercises were online. The teacher indicated that the exercises are carried out either in class or as homework assignments and are e-mailed to her. The feature in the word processing programme immediately highlights grammatical errors and this leaves more time for the teacher to focus on the actual layout of the documents.

Having outlined the above, it is worthy to note that the assessment should be a meaningful part of the learning process and match the learning objectives. As such, the use of technology in assessment should go beyond the much practiced Computer Assisted Learning (CAL). While there is some value to using CAL to the extent that it provides immediate feedback and therefore represents some integration of assessment during the teaching-learning process, according to McCormick (2004):

> *"The image of much of the assessment in CAL is that found in the drill and practice programs; low-level questions based on small amounts of content that have just been studied by the pupils….Typically a pupil is given a question and may choose a response with the program telling her she is 'correct' or 'try again', often ending by telling the pupil the correct answer if she fails repeatedly" (p.120).*

Ideally, therefore the method of formative assessment should be aligned with showing the individual where they need to improve. McCormick (2004) referred to Buchanan's (2000) web-based software PsyCAL which "…provides guidance on what to study, based on the answers to test questions, in a test-learn-retest cycle" (p.124). In short, such software does not automatically give the answer but is designed to actually encourage and assist students in thinking through the problems.

It has been argued that the use of ICT in assessment is also beneficial when applied to certain subject areas. McCormick declares that, "…where the domain is clear and learners' errors and misunderstandings are well known, it is possible to both give feedback that is sensitive to the learner's needs and to vary subsequent tasks based on these" p.121. McCormick (2004) referred to this situation as such that could utilize an Integrated Learning Systems (ILS). However, the assessment has to be such that there is a direct relationship between the work on the ILS and the work being done in the classroom. An ILS may be likened to online or store bought drill and practice software where students practice a skill for some period of time. However, according to the North Central Regional Laboratory's "Critical Issue: Using Technology to Improve Student Achievement", there are two fundamental differences in the ILS and the drill and practice software. They outlined that the two differences between drill and practice and the ILS is that (1) in the ILS the exercises follow scope-and-sequence patterns of instruction found in traditional textbooks and (2) the students' varying degrees of success in completing the exercises determine which set of exercises will be delivered next. To this extent, the ILS used in a school must be part of a comprehensive learning plan that critically examines the school's curricula.

As mentioned previously however the integration of technology for assessment purposes should match the overall learning objectives and as such should be included in the lesson plan. To this end, teachers should engage in some research on the types of technology-related assessment methods and determine which best complements their lessons.

Assessment of the use of Technology by students to Present their Tasks

The use of technology by students to carry out tasks can also provide an opportunity for teachers to assess not only whether students have grasped certain concepts but also their ability to function and succeed in a technology-rich environment. According to North Central Regional Laboratory's "Critical Issue: Developing a School or District Technology Plan, "Because technology continues to play an important role in the modern industrial society, integrating technology into school will help prepare students to succeed in a rapidly changing world." The initiative of allowing students to engage in project-based learning utilizing technology, particularly within a group setting, also gives teachers the chance to assess soft skills. Usher (2000) defines soft skills as those related to problem solving, leadership, collaboration and creativity among others. Dobson (2006) stated that, "Learning and training in soft skills has been considered important with respect to skills demanded in the labour market and practical life" (p.125).

Moreover, the use of technology for presentation purposes is nothing new to classroom activities. Indeed, teachers have been utilizing technology in presenting information to students in lesson delivery for some time. In Barbados, one such form of technology which is extensively used and seemingly preferred by teachers is Microsoft PowerPoint. During the third Empowering Administrators in the Use of Information and Communication Technology Workshop Series conducted by the Ministry of Education and observed by the Education Evaluation Centre, it was noticed that PowerPoint presentations with hyperlinks to video clips, other interactive files or the Internet was the preferred medium for the development and presentation of lessons. While school teams sought to incorporate other software with one school using 'Story Book Weaver' and another attempting to use 'Kidspiration', of the 13 presentations that were made, 11 presenters used PowerPoint with hyperlinks. The question that therefore could be asked is, "Is it feasible to assess students based on their technology-rich presentations and for this form of assessment to benefit students?"

In his 2006 study "The Assessment of Students PowerPoint Presentations – Attempting the Impossible?" Dobson (2006) observed the PowerPoint presentations of seven groups being assessed in a university. The aim of the study was to examine how valid it is to

assess students through their use of PowerPoint. Validity was measured based on the empirical evidence of the study as well as theoretical rationales to support the inferences made from the evidence. Dobson's (2006) empirical evidence indicated that learning took place during the process since the later presenters seemed to take into consideration the comments of the lecturer which were made during earlier presentations. In addition, groups were able to use the lecturer's feedback to improve their presentations before the electronic versions were submitted. The study also commented on the students' actual presentation skills – props used, how they were dressed as well as how they spoke, among others – and the lecturer's feedback on this aspect of the presentation. As such, Dobson (2006) indicated that "The MS PowerPoint presentation was an instance of formative assessment in the sense that students had the opportunity of learning from the feedback received and improving their work before its electronic submission"(p.114).

Therefore the benefits to students of having their use of technology assessed, particularly for presentation purposes, is related to (1) the opportunity to learn from various presenters as there are being assessed; (2) formative assessment through feedback that also enhances learning; and (3) the development of soft skills and actual presentation skills. The challenge is for teachers to determine what weight should be assigned to assessing each element of the presentation or whether the assessment should focus solely on the content and not the form of the presentation.

In essence therefore, the research carried out thus far indicates that apart from the traditional forms of assessment, technology through specialized learning software can provide mechanisms for significant formative assessment. Further, students' use of technology can also provide a chance for them to be assessed not only on the content of their work but on their ability to demonstrate other life skills such as decision making and collaboration. Indeed as students use the technology there is also an avenue for learning from each other. This type of assessment is beneficial to students as it creates an environment where students can receive timely feedback. In such an environment, the teacher can identify recognizable weaknesses and seek to assist students during the teaching and learning process.

The Principal's role as a Leader in a Technology-rich School

(McCarthy (2002) points out that the increasing use of ICT in schools has demanded that the traditional roles of leadership and management in schools be given some thought and "possibly redefining" (p.201). There will always be merit in the view that a leader should possess the qualities such as good communication skills which motivate others. However, Pulley and Sessa (2001) argued that "…adapting traditional leadership skills to a technology-mediated environment adds a layer of complexity that has not existed before" (p. 226). To this end, a Principal in a technology-rich school has to adopt a leadership style that would make the use of technology in the schools benefit not only school administration but student performance as well. Fidler (1997) referred to situational leadership where the person in charge recognizes the situation in which they find themselves and approaches their leadership role based on this recognition. Fidler (1997) further mentioned that much of the early literature on the topic of leadership was concerned with "…'one best way' type approaches" (p.28).

Gurr (2004) indicated that since the 1990s there have been a number of significant developments in ICT which have profoundly impacted the delivery of education in schools. The increasing use of the World Wide Web and multi-media technology as well as the continuous development of technical equipment and software for use in school has caused the availability of vast amounts of information. This situation in schools necessitates a leader who can see technology as an integrated facet of the school environment and not as an entity on its own.

In conducting a systematic review of studies that have been conducted on the use of technology in schools, Harlen and Deakin Crick (2003) indicated that the impact of the use of technology on student performance is generally inconclusive. They mentioned that some studies have shown that there may be some positive impact while others indicated that there is no significant impact. However, the attitude of Principals should be one which suggests that if a decision is made to integrate technology in schools there should be involvement and commitment by all stakeholders in an attempt to make it work. In order for this involvement and commitment to be achieved, the Principal needs to demonstrate passion for the integration at all levels. The North Central Regional

Educational Laboratory advised that in order to prevent a loss of interest in the integration of technology in the classroom, the team leadership must be dynamic and enthusiastic. It is also recommended that the leader's expectations should be realistic and the timeframe for meaningful implementation must be reasonable.

To this end, Principals who see themselves as technology leaders in their schools can only auger well for the enhanced delivery of the curriculum which will ultimately benefit students. This is so because such a Principal is cognizant of the need to establish a team of persons who can develop a technology plan to match the curriculum. A Principal with a vision to use technology for the improvement of the school's performance is also aware that he/she cannot lead the process single handedly and that at times may need to give way to others who, having the same goals in mind, may be better able to influence some aspect of the vision. Researchers (Spillane, Halverson and Diamonds (2001, 2003)) who have studied leadership in organizations including schools, referred to this phenomenon as 'distributed leadership. Gurr (2004) however cautioned that the leader has "…to decide when to use control while increasing collaboration" (p.118).

Manasse (1984) suggests that it is this organizational vision that is essential for effective leadership. The effective leader understands growth and change in the system, has a vision of a better future, and has the skills necessary to bring all the individuals and subsystems into congruence so that all work towards a common goal.

The Principal however must recognize that there may be some members of staff who may not be sold on the integration of technology in the classroom and that this may limit some students' exposure to the opportunities that the integration could have offered. In light of this, it is suggested that effective Principals identify influential teachers and develop a strategy to get those teachers meaningfully involved in sharing and fulfilling the vision. The inherent implications of the integration of technology into the school environment will therefore require a technology plan which seeks to enhance the school's activities and essentially student achievement.

Developing a Technology Plan

A technology plan should not be developed in a vacuum but instead should be one component of a school or education reform plan. It should be developed only after serious consideration has been given to the overall objectives of the school and when it has been determined how technology can be used to achieve those objectives. Moreover, in planning to introduce technology into schools in a meaningful way, there should be careful thought regarding who will be using it and in what way.

In developing a technology plan that would therefore be advantageous to the teaching-learning process, there should be an understanding of how students learn, what they should attain at particular levels and then how technology can be used to enhance education. The plan should include technology for learning that is researched and that is thought to be that which is suitable to improving academic achievement. In order to carry out this task, schools should establish a technology team to look at these issues. Graduate students of the Mississippi State University under the instruction of Dr. Larry Anderson (1996), advised that the technology planning team should comprise representatives all of stakeholders including students and parents.

Benefits to both teachers and students in the use of technology are not only derived from access to the most suitable technology but also to technology which is properly maintained. Hardware which is available but is not functioning is of no worth to anyone. To this end, within the technology plan there should be a maintenance plan which addresses the up-keep and up-grading of equipment. Non-functioning, out dated equipment is the source of much frustration to teachers who are willing to use technology as a tool to engage students and transfers knowledge. In their 1996 "Guidebook for Developing an Effective Instructional Technology Plan Version 2.0, the graduate students at Mississippi State University supervised by Dr. Larry Anderson outlined a number of points to consider in developing a technology plan. Among these points were:

- Avoid maintenance problems before they arise by keeping equipment in conditions conducive to their longevity.
- Develop a budgetary process to provide for on-going repairs.
- Train people from the school to provide repair services.

- Consider purchasing equipment with vendors whose contracts include warranty packages and who provide special training.
- Monitor all computer laboratories frequently used by students to prevent maintenance problems.

Included in the above points are two of the mechanisms that are in place in at least one secondary school in Barbados. At this secondary school one of the key elements to making sure that the equipment functions is the establishment of their ICT Support Team. This team is made up of students who have been trained to recognize problems and carry out repairs on computers in the laboratories. This experience is beneficial to the students not just to the extent that they receive the practical training but also to the extent that it prepares them for taking on challenges and exhibiting responsibility traits. In addition, at the school computer laboratories and equipment are continuously monitored. Only during lesson time or when supervised by a teacher, can students occupy the laboratories and once inside each student is responsible for the equipment they use and turning in any peripherals that they were using before leaving the lab.

The above discussion examines the fact that a technology plan should take into consideration the technology needed to match learning objectives and the maintenance of the equipment. However, in addition to these matters built into the plan should be an evaluation mechanism. As suggested by Gosmire and Grady (2007) the technology plan should state how the process of technology integration will be evaluated in order to assess its effectiveness. Gosmire and Grady (2007) argued that "The success of the technology plan should be measured in a formative and summative manner" (p.17). They indicate that the formative evaluation will provide feedback from the various users of the technology and therefore should include benchmarks such as "…implementation dates, confidence ratings and usage rates" (p.18). The summative evaluation, they advised would influence the goals and objectives of the school in future technology planning. This being said, the duration for the implementation plan should not be too long primarily due to the fact that technology is consistently changing. In fact, the literature suggests that the implementation of the technology plan should be no longer than five years.

Essentially the Principal can ensure that the integration of technology benefits the students in his school by recognizing that he must demonstrate an authentic interest in the use of technology in the classroom so that teachers can be encouraged by his enthusiasm. In addition, the Principal must facilitate the planning process of the integration of technology where the major focus should be on determining the technology that is most relevant to the learning objectives.

The Use of Technology in Administration

The use of technology in schools to create an advantageous learning environment need not be restricted to the use of technology for pedagogical purposes directly. In fact technology use in areas such as record keeping, communication, and accounting among others, all have some impact on the learning environment and the benefits that can be accrued by the students. Data collection is carried out at every level of the school setting and this data is critical to the decision making process. Bernhardt (2005) indicated that in order for access to data to effectively work for the school, it must be managed using the correct 'tools'. Bernhardt (2005) referred to these tools as being student information systems (SIS), data warehouses and instructional management systems.

Student Information Systems (SIS)

SISs are information systems where demographic student information is inputted and stored. Many SISs are also designed to collect information on students on a daily basis and records the school attendance, class attendance, indiscipline, and tardiness among other information. Such data can be retrieved and analyzed to inform a decision on a student or group of students. In her study, "Data Tools for School Improvement: Bernhardt (2005) outlined the following:

> *A well-designed student information system enables school personnel to study important measures of student engagement, such as attendance, discipline, and suspensions, and to fully analyze problems before attempting a solution. For example, one year, Eastern school assistant principal suggested that they more closely review the numbers on discipline referrals in their student information system. This closer look revealed that a large proportion of the referrals were for*

> *the same group of boys being reprimanded on the playground only on Monday, Wednesday, and Friday mornings and always by the same part-time supervisor Close analysis of the data revealed that a new school wide discipline program would not be an appropriate solution (*p. 67).

Likewise, data is collected on students on entry to the school which can be quite useful in determining the type of student which the school has to cater to. This type of information should guide the type of academic and social programmes that are implemented in the school. Nobles (2004) stated that by identifying student's strengths and weaknesses, teachers can plan their lessons more effectively while administrators can suitably allocate financial resources. This would assist in making sure that the appropriate resources are acquired.

Data Warehouses

A data warehouse houses several different types of databases. These databases can range from student information such as school attendance and tests grades; to databases on the school programmes such as timetables and lesson banks. Such a collection of databases in a central place provides school administrators with the necessary quantitative and qualitative data to carry out analysis that generates in-depth information. Bernhardt (2005) states that data stored in data warehouses can be used to conduct longitudinal studies. She pointed out that cohorts of students can be studied over a period of time and the factors which influenced the cohort's performance overall could also be examined and used to determine what issues the school should pay attention to in the future. For example, data warehouses can be used on a system-wide level to assist education ministries and school district authorities in using several types of data to engage in analysis and triangulation to inform policy decisions. This process could be used to try to make policy more relevant to the needs of the teachers and by extension the students. In her study Bernhardt (2005) referred to the Evergreen School District's use of their data warehouse to analyze data on student demographics, instructional methods and preferred learning styles. She mentioned that the schools district authorities realized that students of lower income homes learnt better when content was presented in an 'active format' and that high school girls generally had significantly higher grade point averages than

boys. By discovering this type of data, the authorities can take steps to address the problems.

Instructional Management Systems

According to Bernhardt (2005) "Instructional management systems help analyze student performance on ongoing assessments and reveal how closely student learning matches the content a teacher has presented in class" (p.68). A web-base instructional management system can assist teachers and students by improving the teacher's ability to match what the students know with what they do not know and then generating lesson content. As such, these systems provide resources to assist in raising the performance of students in their subject matter tests. In the study, "Use of an *Instructional Management System* to Improve Mathematics Skills for Students in Title I Programs." Ysseldyke, Betts, Thill and Hannigan (2004), stated:

> *We sought to ascertain the extent to which teacher use of a curriculum-based instructional management system (Accelerated Math™) as an instructional enhancement that enabled them to monitor student progress and adapt math instruction would result in significantly greater gains in mathematics achievement for students in Title I programs than for Title 1 students whose teachers did not use a curriculum-based instructional management system (p.12).*

Ysseldyke, Betts, Thill and Hannigan (2004) indicated that they compared the two groups by examining variables such the number of mathematics problems they attempted, the percent of problems answered correctly, the number of test they took and the percent correct on the test and the objectives they mastered both in class and in the library. They also pointed out that they carried out statistical analyses on the data collected and reported that the experimental group "demonstrated significantly more accurate performance" (p.14).

Essentially, instructional management system can assist teachers in setting objectives, pre-assessing students, planning lessons, teaching the stated objectives, obtaining feedback, and post-assessing students. In addition, school administrators and system-

wide administrators are in a better position to document student performance and make realistic decisions to improve learning outcomes where necessary.

The Use of Technology in Administration in a Barbadian School

This school is located in St. Michael Barbados and is considered to be on the forefront of technology integration in various aspects of its operations. One such aspect is the area of administration. The following report on the school's use of technology in administration resulted from an interview with the Information Technology Coordinator on September 25, 2008.

Outline of Salient Points from the Interview

The school has an Education Management Information System (EMIS) which was developed by the Principal and has been in use since 1995. The EMIS, which is used by both teaching and administrative staff on a daily basis, has evolved from a Microsoft Excel file into a web-based system since 1998. It includes information on students, staff, and general school information.

Students

Student records on the EMIS include a photo of each student, their address, name of their parents and contact numbers. Further, student performance can be easily monitored using the system. Teachers use the 'Personal Mark Book' feature to enter students' marks into the system. From the marks, the 'Personal Mark Book' feature works out the percentage automatically and prepares it for the inclusion in the students' final reports. The 'Personal Mark Book' feature also allows students' marks to be checked by class and by subject for a particular period in any academic year. Continuous assessment has also been recently added to the system.

In addition, teachers can also use the system to liaise with the Principal regarding students' behaviour. This feature allows teachers to send an online message to the Principal regarding a student's indiscipline, including what action has been taken so far on the matter and await response via the same report module. The system also contains testimonials and other documents that past students may request.

Staff

Each staff member has a password to access the information on the EMIS. However, what information they are able to access is determined by the staff member's status. Additionally, each teacher has an online page with data such as personal information, attendance register, and their timetable. The teacher is responsible for updating the information on his or her page. In addition, each department has its own webpage on which the Head of Department is supposed to upload the syllabus as well as the schemes of work for each subject at all five levels.

Curriculum

Departmental folders have been created for all subject areas on the desktops of all workstations in the computer rooms and staff points. Shortcuts to the relevant curriculum software and tools, has also been placed in the folders. The EMIS also includes a feature entitled 'The Timetabler'. This feature enables users to check the various timetables by teacher, form, subject and room among other information.

There are also six computer rooms; however, each teacher was given a lap top computer during the summer vacation of 2008. To this end, teachers spent approximately two hours with the Information Technology Coordinator (ITC) to configure the computers for use. As of September 2008, fifty eight laptops had been distributed in this manner. Teachers also have self-help groups and these groups all have a natural leader. In the event that teachers experience problems with the technology, their first contact should be with their colleagues. If the group is unable to resolve the problem, an email is sent to the ITC. The solution is then emailed to everyone as part of a frequently asked questions (FAQ) series.

General Use of the EMIS

The school's EMIS has a number of features which are used to make the administrative aspect of its operations run efficiently. One such feature is the administrative blog where staff can discuss issues electronically. This blog had been in use since 2006 and its use has been advanced in that the school had its first virtual meeting on Monday September 22, 2008. Each member of the administrative team was able to stay at their desk and participate in the meeting by sending and receiving messages via the computer. The use

of computers throughout the school is becoming even more wide-spread since there are now two wireless networks using three access points connecting to the LAN. ADSL is used as a backup for Internet connectivity.

In relation to maintaining the hardware, the school has a group of students who assist in repairing the equipment. This ICT Support Team identifies the problem and determines what part is needed. The ITC makes a request to the Ministry of Education and once the part is received, the students repair the equipment. The team members produce regular reports on the status of the workstations in computer rooms.

The above discussion of what occurs in at least one secondary school in Barbados is an example of how technology can be used in the general administration of the school. The ITC mentioned that while they were generally pleased with the use of technology in the school thus far, they recognisd that there are many possibilities and therefore with the ever-present support of the Principal they are always seeking ways to expand the use of technology to improve the school's operations, maintain teacher satisfaction and enhance students' interest in learning.

Based on the proceeding discussion it is evident that schools have a major responsibility in ensuring that students really benefit from technology. This can be accomplished when technology is used to enhance educational goals and not as an entity itself. Technology must be part and parcel of the instructional process facilitating student achievement and 21st century skills. Particular emphasis should be technology integration, teacher professional development, assessment and the leadership principal. More importantly, the use of technology should be guided by curricula goals.

BIBLIOGRAPHY

Anderson L., et al.; (1996). Guidebook for developing an effective instructional technology plan version 2.0. Mississippi: Mississippi State University.

Antifaiff, G. Integrating technology into the curriculum. Retrieved on November 15, 2008 from http://www.usask.ca/education/coursework/802papers/antifaiff/antifaiff.pdf.

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why isn't it happening? *Journal of Technology and Teacher Education*, 13 (4), 519-546.

Bernhardt, V. (2005) Data tools for school improvement: These strategies will help schools select an appropriate and effective data system, *Educational Leadership*, 62(5), 66-69.

Burke, K. (2007). Infusing technology in Australian teaching and learning through the use of project base-based learning. Retrieved November 21, 2008 from https://www.det.nsw.edu.au/media/downloads/detawscholar/scholarships/yr07report/part2/kburke.doc.

Burnett, A., & Thompson, B. (2008). *Report on the third empowering administrators in the use of information and communication technology workshop Series*. University of the West Indies, Barbados: Education Evaluation Centre.

Critical Issue: Developing a school or district technology plan. Retrieved November 11, 2008, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te300.htm.

Critical Issue: Using technology to improve student achievement. Retrieved November 10, 2008, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te800.htm.

Dias, L., & Atkinson, S. (2001). Technology integration: best practices–where do teachers stand? *International Electronic Journal for Leadership for Education* 5 (10).

Dobson, S. (2006). The Assessment of student PowerPoint presentations – Attempting the impossible? (Electronic version). *Assessment and Education in Higher Education,* 31(1).

Fidler, B. (1997). School leadership: Some key ideas (Electronic version). *School Leadership and Management,*17(1).

Gosmire, D., & Grady, M. (2007). 10 Questions to answer for technology to succeed in your school (Electronic version). *Education Digest*, 72(8), 12-18.

Gurr, D. (2004). ICT, leadership in education and e-leadership. *Discourse: Studies in the cultural politics of education* (Electronic version). 25(1), 113-124.

Harlen, W., & Deakin Crick, R. (2002). A systematic review of the impact on students and teachers of the ICT for assessment of creative and critical thinking skills (Electronic version). Research evidence in education library. London: EPPI-Centre, Social Sciences Research Unit, Institute of Education, University of London.

Heap, N. W., Kear, K. L., & Bissell, C. C. (2004). An Overview of ITC-based Assessment for Engineering Education (Electronic version). *European Journal of Engineering Education*. 29(2).

Hopey, C., & Harvey-Morgan, J. (1995). Technology for adult literacy practice guide. National Centre on Adult Literacy, University of Pennsylvania.

Kanaya, T., Light, D., & Culp, K. M. (2005). Factors influencing outcomes from a technology-focused professional development program (Electronic version). *Journal of Research on Technology Education*, 37(3), 313-329.

Manasse, A. L (1984) Principals as leaders of high-performing systems. *Educational Leadership*, 41(2), 42-46.

McCarthy, M. M. (2002). Educational leadership preparation programs: A glance at the past with an eye toward the future. *Leadership and Policy in Schools*, 1(3), 201-221.

McCormick, R. (2004). ICT and pupil assessment (Electronic version). *The Curriculum Journal*, 15(2).

Mcgrath, B. (1998). Partners in learning: Twelve ways technology changes the teacher-student relationship (Electronic version). *T.H.E. Journal,* 25(9), 58+.

Nobles, K. (2004). Student data information systems: expanding what you already have (Electronic version). *Media and Methods*, 41(1), 18-19.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? (Electronic version). *Educational Researcher*, 29(1), 4-15.

Sandholtz, J.H. (2001). Learning to teach with technology: A comparison of teacher development programs. *Journal of Technology and Teacher Education*, 9 (3), 349-374.

Smith, S. (2000). Graduate students' mentors for technology success (Electronic version). *Teacher Education and Special Education,* 23(2), 167-182.

Spillane, J. P., Halverson, R., & Diamond, J. B. (2001). Investigating school leadership practice: A distributed perspective (Electronic version). *Educational Researcher,* 30(3), 23-28.

Spillane, J. P., Diamond, J. B., & Jita, L. (2003). Leading instruction: The distribution of leadership for instruction (Electronic version). *Journal of Curriculum Studies,* 35(5), 533-43.

Sugar, W. (2005). Instructional technologist as a coach: impact of a situated professional development program on teachers' technology use journal (Electronic version). *Journal of Technology and Teacher Education.* 13.

Swan, K., Bowman, I. E., Jr., Holmes, A., Vargas, J. D., & Richardson, J. (2000). Technology, professional development and the culture of the schools. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Swan, K., Kratcoski, A., Mazzer, P., & Schenker, J. (2005). Bringing Mohamed to the mountain: Situated professional development in a ubiquitous classroom (Electronic version). *Journal of Technology and Teacher Education***.** 10(2), 169-190.

Thelwall, M. (2000). Computer based assessment: A versatile educational tool (Electronic version). *Journal of Computers and Education*, 34, 37-49.

Usher, R. (2002). A diversity of doctorates: Fitness for the knowledge economy? (Electronic version). *Higher Education Research and Development Journal*. 21(2).

Wells, D. L., Wells, J. G., & Mitchem, K. (2003).Effective integration of instructional technologies (IT): Evaluating professional development and instructional change (Electronic version). *Journal of Technology and Teacher Education*, 11 (3), 397+.

Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development (Electronic version). *Review of Research in Education,* 24, 173-209.

Ysseldyke, J. T., Betts, J., Thill, J., & Hannigan, E. (2004). Use of an instructional management system to improve mathematics skills for students in title I programs (Electronic version), 48(4), 10-14.