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SCHOOL INFORMATION AND COMMUNICATION TECHNOLOGY IN DEVELOPING COUNTRIES: ESSENTIAL CONSIDERATIONS FOR IMPROVEMENT

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Abstract
In developing nations, such as many in Africa, providing teachers, students and other school personnel with adequate access to Information and Communications Technology (ICT) remains a daunting task for schools and education supervising/controlling agencies, such as school boards, school districts, Ministries of Education. ICT funding is difficult to find and prevailing budget practices in developing countries make necessary changes even more difficult to accomplish. Finding innovative ways to plan, budget, and fund new and existing ICT infrastructure or redirect existing funds into new endeavors remain a daunting challenge to school personnel, especially at a time when new resources for schools appear to be limited. This article discusses considerations teachers and other school personnel, especially in developing nations such as those in Africa, should make regarding planning, budgeting and funding ICT in order to improve teaching and learning in the 21st century environment.
Keywords: School, Information, Communication, Technology, Budgeting, Planning, Funding.

Introduction

In developing nations, such as many in Africa, providing teachers, students and other school personnel with adequate access to Information and Communications Technology (ICT) remains a daunting task for schools and education supervising and controlling agencies, such as school boards, school districts, and Ministries of Education. ICT is relatively small portion of total school funding, so ICT money is difficult to find (Kaestner, 2007). In addition prevailing budget practices in developing countries make necessary changes even more difficult to fund and accomplish. This makes proper planning and budgeting of financial resources with which to purchase information communication hardware and software, other devices, and training of personnel very essential. For any effective and efficient school, ICT is costly and requires the purchase of expensive equipment and infrastructure, mostly computers and related peripherals, as well as continued expenditures for maintenance and staff training. Computers and other peripherals require large expenditures every three to five years, a time frame not usually

considered in educational planning as few school districts or local education agencies budget-systems can accommodate such expenditures (Schaffhauser, 2012). Finding innovative ways to plan, budget, and fund new and existing ICT infrastructure or redirect existing funds into new endeavors remain daunting challenges to school personnel, especially at a time when new resources for schools appear to be limited. There is evidence that improved teaching and learning leads to higher quality education for the masses. As such providing quality education helps improve a nation's level of economic and technological development (Abram, 2014; Ngware, Ciera, Musyoka, & Oketch, 2015; Morton, 1996). This article discusses considerations that teachers and other school personnel, especially in developing nations such as those in Africa, should make regarding planning, budgeting and funding ICT in order to improve teaching and learning in the 21st century environment. Throughout this discussion, the term "school district" means the local education authority (LEAs), i.e. school district, school board, ministry of education, etc., that is responsible for education within its jurisdiction.

Planning Considerations

To many teachers, school administrators, and school business officials, getting a grip on the complexities of ICT administration can be an enormous challenge. This is so because ICT systems are unlike most other familiar areas; the topics are very technical and the pieces to the puzzle are obscure. While the specifics of carrying out ICT plans may vary widely across schools, the planning process entails several general steps: evaluate the situation; articulate a vision; decide on a mission statement; develop goals; develop a strategic implementation plan, including short- and medium-range plans; and set up a procedure for assessment and periodic revision of the plan (Bielefeldt, 1997; Kaestner, 2007; Ritzhaupt, Hohlfeld, Barron & Kemker, 2008; Schaffhauser, 2012). The level of detail needed to make good decisions about an ICT budget requires business officials to be savvy in their approach to planning, procurement and project management. Ritzhaupt et al (2008) and Wodarz (1998) outlined key factors that many, including the author, have found very helpful when planning and budgeting technology resources and programs for schools. These are (a) developing a clear ICT plan and a structure for decision making, (b) defining roles and responsibilities, (c) understanding technical requirements, (d) acquiring and maintaining proper technology system, (e) providing and managing adequate staff to support the system, (f) overcoming fear, communicating, and connecting technology to the instructional and learning, and (g) evaluating the use of ICT.

Clear Technology Plan and Structure for Decision Making

The first component for success is the development of a clear ICT plan, which must set forth the vision for technology use in the school district by defining the current status of ICT. It should also include a needs assessment that includes all the areas where ICT will be used. The plan should be flexible enough to encompass change as new technologies emerge. A thoughtful plan will provide the structure for decision making throughout the implementation process; squabbles regarding software or hardware will be minimized if the plan is adhered to. This will help ensure that all systems will support one another and share information; and it will also help minimize the isolation of systems across the school district. Being able to share information is a valuable asset for teachers and administrators. There is a negative impact on systems that do not work together, i.e., cost increases and problems in efficiency and accuracy. It is also important to purchase scalable systems that will grow with the district's needs and with technological advancement.

Once a technology plan is in place, then a decision making structure should be established and incorporated it into the plan. It is helpful if the decision makers are experts in their particular areas, e.g. network technicians probably should not choose educational software and teachers should not be making infrastructure decisions. However, the groups should work together because the types of instructional activities to be performed will require specific infrastructure components. One useful method is to convene a standards committee. This committee's responsibility would be to work as a team to develop network, hardware, software, and training or professional development standards. The committee, for example, might determine that all software purchased in the district must run on the Windows platform, that all hardware purchased must have a minimum of four to five years warranty, and/or that all computers (servers, desktops, & laptops) must be made with Intel or AMD processors and from one or two specific manufacturer(s). By developing standards and streamlining the decision-making process, fewer purchasing errors will be made.

Define Roles and Responsibilities

When it comes to technology purchasing, there are numerous stakeholders whose duties and responsibilities may blur and overlap. Defining who is responsible for the various areas of technology purchasing can alleviate much stress and strain during the implementation process. It is important to formally define these areas of responsibilities. Before the planning and/or purchasing process begins, be sure to include school board members, curriculum and technology staff, administrators, teachers, contractors and community members. Many times we forget to allow these people to play out their roles and to positively reinforce their involvement. Success is dependent upon the complete cooperation of those involved. One of school administrators' responsibilities is to make the participation in ICT projects rewarding to shareholders, as well as to value the team's efforts.

Understand Technical Requirements

Because it is very difficult, if not impossible, for even the most adept school administrator to know all about the pieces and parts of complicated network and hardware systems, the purchase of ICT systems can be confusing. As we become increasingly dependent upon our technology systems, we cannot afford to choose the wrong system or suffer due to lack of technical support from a company. School administrators or leaders, with the assistance of competent ICT personnel, must ensure that the technical requirements for all systems are aligned with both the instructional and administrative systems. The systems must be compatible and support the outcomes for both sides of the educational house. When choosing hardware, specific technical requirements should take into consideration the future ability to upgrade the systems as well as the availability of long-term warranties and support services (Vanderlinde & van Braak, 2013). The task of choosing new software is also complex. One solution to this problem is to consider purchasing integrated software packages designed to work with one another. Even then, data transfer is less than flawless, but it is still better than can be expected from independent packages. It is always a good idea to thoroughly test all new hardware and software systems in the school's environment, not somewhere else. Always remember to ask your technical personnel or advisors "Does it really work?".

Acquire and Maintain Proper Technology Systems

After a thorough understanding of the technical requirements, it is time to determine what funds will be allocated to those purchases. Many school districts and/or education-supervising agencies view technology as a capital purchase, much the same as purchasing school buses or classroom furniture. It is common to find that these agencies pay for technology with burrowed or bond monies over a long period of time (Sundeen & Sundeen, 2013). However, unlike other capital items, technology becomes obsolete in a very short time, yet everyone is still paying for it years after its usefulness has elapsed. It is more fiscally prudent to treat ICT as an operating expense. Leasing systems may be a viable option for many schools. Others may be able to build replacement lines into their operating budgets to avoid lapses in current technology. It is also a good rule of thumb to ensure that the systems purchased today will be adequate in three to five years, with only minor enhancements. One rule of thumb is to always purchase hardware with at least four to five years replacement warranty coverage. Consider purchasing standard systems from reputable vendors who will still be in business after the warranties run out.

Provide and Manage Adequate Staff to Support the System

After purchasing and installing the new system, maintenance becomes the primary focus. To do this effectively, there must be enough technical staff available to keep the systems functional. Finding adequate staff in the current marketplace is very difficult. Few schools can offer competitive salaries for technicians, and even fewer can retain the technical staff they do hire. Besides less than competitive salaries, technical staff leave schools because they do not receive on-going training or competitive compensation (Sundeen & Sundeen, 2013). Knowing that their skills need to remain current, they move to other organizations that compensate them better and provide on-going technical training. In addition to hiring fulltime technical staff, take creative approaches to staffing such as hiring secondary or technical school graduates and training and retaining them on a part-time basis.

Many schools think the only way they can maintain their computer systems is to hire their own staff (Levin & Schrum, 2014). This can prove to be the most costly and inefficient means of keeping the school's ICT functional. Consider service options, some of them are quite useful. For example, use the warranties that come with the systems, especially if the purchase is from a reputable manufacturer. There is a small amount of paperwork required, but it will provide years of service that will serve as the first line of defense when the systems go awry. The second option is to consider working with contracted services. An increasingly large number of companies are beginning to offer maintenance contracts to schools and/or government agencies that have control over school ICT (Scigliano & Hundley, 2012). They are sensitive to the unique needs of schools and will work with the school system to create a maintenance profile that will fit your needs.

Even with the appropriate staff and technology, it is still necessary to manage the installation of the systems and their upkeep. It is helpful to have regular meetings with the people involved in the project, to assign tasks and to follow up on their completion. One project management technique used in other areas but relevant here is to set critical benchmarks and track progress until everything is completed. As part of the planning process, be sure to allocate human and financial resources carefully and allow for adequate (ranging from a few months to a year) system testing and training for all the users.

Overcome Fear, Communicate and Connect Technology to Instruction and Learning
Fear is one of the greatest impediments to ICT implementation. Users are afraid that the new system will negatively affect their ability to do their jobs. Many are concerned that the technology will replace them, while others are fearful that it will take them too long to learn to use the new system. The most effective way to overcome these fears is to offer comprehensive training programs. If the staff is knowledgeable regarding the implementation process and is comfortable using the new technology, their fears will be minimized dramatically.

Communication is usually the key factor in the success or failure of every endeavor. ICT implementation is no different. The ICT plan should define specific avenues for both internal and external communications. When the key stakeholders are aware of the decision-making process and the progress of the project, they are much more likely to be supportive.

As technology is purchased to be used as instructional tool, school administrators need to be certain it supports the designated learning outcomes for students. Anything short of that will be counter-productive and unacceptable by the stakeholders. Children come to school to learn a wide variety of skills and concepts. It is our job as educational leaders to provide the tools for them to be successful. The most important aspect of infusing ICT into the instructional program is training teachers to be effective users of the available systems. If instructional specialists are not using the current systems to their maximum potential, there is little likelihood that funding agencies will continue to invest in new technologies. It is everyone's responsibility to ensure that any technology used in the school can be justified by the positive impact it has on students' achievements.

Evaluate the Use of Technology
The people who most actively support public education are most interested in what technology can do for their children and how it is being used in the classrooms to help their children improve and become the best they can be. Therefore, be careful to explain how the technology that was purchased will impact the education their children receive. The effects of technology on learning and teaching are not necessarily quantitative in nature.

Budget Considerations
Cost Considerations. Many ICT advocates have long argued for a standing appropriation for ICT in school budgets. Various proportions have been suggested, from 2 percent of per-pupil expenditure to about 15 percent of per-pupil expenditures (Johnson, 2012; Keltner & Ross, 1996; Morton, 1996; Ritzhaupt et al, 2008; Thomburg, 1994). The exact amount will vary with the state, community and school, but the argument is that technology requires an ongoing investment (Johnson, 2012). School personnel responsible for making ICT budget decisions should estimate the total cost involved when purchasing technology and computers, wiring the school, connecting classrooms and/or the entire school to the Internet, etc—a concept known in the business world as Total Cost of Ownership (TCO). TCO assessment helps organizations make intelligent purchasing decisions for products that require installation, training and support (Picus, 1998; Schaffhauser, 2012). It includes all costs involved in operating and maintaining all technology equipment and resources, including network systems. It is traditionally used by businesses to help control costs and make strategic decisions. For schools, as is true for businesses, calculating and assessing TCO should become an important

part of ongoing school technology budget planning. The analysis will assist in factoring in the major decisions and expenses required to prepare for beyond the cost of the hardware.

Total Cost of Ownership (TCO) Analysis

Support costs. Has the district adequately budgeted for staff to maintain the network and other hardware and to help others solve software and hardware problems? One of the thorniest issues schools face is how to provide adequate support for their networks and technology equipment and resources scattered all over the buildings in the school system. This generally concerns staff and tools to keep computers, networks, and other technology devices and resources operating efficiently and effectively. It also involves additional dedicated staff to help teachers and other school personnel learn how to integrate technology in the classroom and support-service offices.

Professional development costs. Has the school district budgeted adequate amount (derived from TCO) for staff training, including the cost of trainers, materials and substitutes if training is conducted during school hours? The budget item that arguably is most critical to a school system's ability to achieve its ICT goals is staff development (Johnson, 2012; Schaffhauser, 2012). If teachers and other staff members do not understand how to use new technologies and incorporate them into the classroom or office/service functions, a school's ICT investment will not achieve its desired results. Inadequate staff training will lead to under-utilization of computers and technology resources—and a loss of return on a district's investment in technology.

Software costs. Has the school or controlling state agency adequately budgeted for network management software, computer-based curriculum materials, applications and productivity software, and the software needed to adapt technology to the special needs of users? Many calculations of the costs of networking schools provide only for basic application software and not the costs of software that could be considered purely instructional or part of the budget for curriculum materials (Hawkes, 1998). The shift to digital learning requires schools to be committed to true integration and creating new learning models to improve academic performance (Schaffhauser, 2012). Requisite for that shift is an inventory of digital content clearly linked to specific performance standards and a well-managed deployment of software across the school system.

Replacement costs. Has the school adequately budgeted to cover the costs of replacing computers and other peripherals? When installing dozens of new multimedia computers or a robust network, it's easy to forget that the day will come when hardware will need to be replaced. Computers, servers, networking equipment, software, and peripherals have a life cycle of three to five years, depending on the equipment or software and how it is used (Ramaswami, 2008). Planning for these life cycles should begin with the initial purchase and installation.

Connectivity costs. Has the school, district or state agency adequately budgeted to cover costs involved with connecting schools to each other and to the Internet? Schools may decide they can afford to purchase only a certain level of connectivity. However, there will be a tradeoff in terms of the speed with which students and staff can communicate, connect to the Internet, and download graphic and video-intensive files. This, in turn, could have an impact on how staff members and students spend their available time.

Retrofitting costs. When the district is ready to build a network, has it adequately budgeted to upgrade electrical capacity; improve heating, cooling and ventilation systems; beef up security systems; and remove asbestos and lead found in older buildings? It is hard to predict a formula to help determine how much you will have to spend to wire existing buildings. The best time to wire a school is obviously when it is under construction, or in the case of an existing building, when it is being renovated or expanded. Retrofitting is not traditionally part of Total Cost of Ownership (TCO) analysis, but it is a cost that schools frequently face and sometimes fail to anticipate (McIntire, 2004).

Calculating Technology Cost

Regardless of the role ICT plays in a school system, appropriate school personnel should know the costs associated with ICT, understand the consequences of technology purchases and be able to measure the benefits of ICT so they can make more informed decisions. However, determining costs and benefits of current technology or proposed projects is difficult because the value of ICT for education is viewed differently than for businesses. For example, businesses use processes like Return on Investment and Net Present Value to project costs and benefits of proposed projects with an eye to increasing bottom-line or top-line dollars. In contrast, educators focus on addressing non-monetary goals and mandates such as improved student performance, equity and 21st century skills (Ritzhaup et al, 2008). And unlike businesses in the corporate world, rural school districts must answer to constituent concerns over expenditures. School district personnel can better understand current ICT costs and more easily determine the value of proposed projects using a couple of valuable tools: Total Cost of Ownership (TCO) and Value of Investment (VI).

Total Cost of Ownership for technology is a method for determining all of the costs associated with implementing and maintaining computers and networks (McIntire, 2004). Once TCO is determined, teachers and/or school personnel will be in a better position to make decisions concerning overall efficiency and plans for the future. The TCO methodology examines three major cost categories: annualized technology costs, direct labor, and indirect labor:

Annualized technology costs are the amortized costs of client desktop/laptop computers and devices, network equipment, servers, software, printers, supplies and external service providers. Direct labor costs are the district's burdened costs for all personnel who have responsibility for buying, implementing, maintaining and managing the technology infrastructure. Those with part-time responsibility are counted for the portion of their time assigned. Teachers and other school staff who provide technical support as well as any outsourced services should also be included. Indirect labor costs reflect the time users spend in training and dealing with system and application issues that affect productivity. While indirect labor is not a line item in the budget, loss of productivity represents a real cost to the school system. Resulting TCO metrics such as per client-computer costs, number of computers per support staff and number of students per available computer also can help measure and allocate resources for improved efficiency, improve the budgeting process and make more informed decisions concerning planned ICT initiatives (McIntire, 2004).

Total Cost of Ownership answers the question, what is my ICT infrastructure costing me, while Value of Investment answers the question, which way should we go (Kaestner, 2007). While there is no one "right" set of numbers for TCO, the TCO tool allows a district to evaluate its own decisions over time. It took many years for businesses to learn the language of total cost of ownership; now school administrators have the opportunity to build on that experience to suit the requirements of their own environment. Once school administrators better understand the true costs associated with ICT, they will be better equipped to protect their district's significant investment in ICT, as well as be better able to evaluate whether ICT is truly serving the district's educational goals.

TCO Analysis Resource

There are several organizations that serve as TCO analysts. One of these is Gartner and the Consortium for School Networking (CoSN), a non-profit organization that serves in education technology leadership, provides a Web-based TCO tool designed to help schools and school districts make sound budgetary decisions, conduct technology planning in an organized way, establish a baseline for future analysis and maximize benefits from their investments in technology. This smart budgeting tool, funded by the U.S. Department of Education and sponsored by the North Central Regional Technology in Education Consortium (NCRTEC, 1996) at the North Central Regional Educational Laboratory (NCREL), presents a framework for looking at TCO issues in the school setting. For developing countries, they will want to invest access to similar analysts and cost analysis software. UNESCO may provide updated information on such resources. The online tool is a vendor-neutral, free resource available to help schools and districts manage their computer networks in a cost-effective way.

Another factor to consider in budgeting is the time required to implement systemic change. Simply installing technology, for example wiring a school or installing Smart Board in all classrooms, can be accomplished in a short period. Actually integrating that technology in instruction will take years—perhaps three to five. This has implications for the length of financial commitment as well as for evaluation. Teachers and students will need time to incorporate the new technology tools into school activities, especially instruction and learning.

Funding Considerations

Categorical Funds. Schools tend to fund technology purchases through non-regular revenue sources including categorical program funds or grants (Lovitt, 2004; Ramaswami, 2008). Categorical funds are often problematic for schools to finance ICT because they usually come with restrictions on their use, specify which students receive the benefit, focus specifically on the acquisition of technology, and usually don't provide funds for maintenance and operation of the equipment or resource once it is in place. Additionally, these programs often provide one-time funding, leaving schools to find their own financial resources to pay for replacement when the equipment resource wears out. While categorical funds are welcomed and remain one reliable funding source, schools would be better served if they found other ways to budget for routine replacement of computers, peripherals and other infrastructure needs on a regular basis. Two approaches for doing this seem helpful, although not widely used by schools. The first is the creation of a "revolving fund" for such purchases and the second is closer articulation between administrative and instructional computing systems (Tetreault & Lanich, 2007).

Revolving funds. The average computer purchased for use in a school probably has a useful life of three to five years. Budget procedures in many school districts do not reward schools for saving resources in one year to make large purchases in the next year. As a result, schools often are unable to make a large coordinated purchase of computers and associated equipment at one time, i.e., replacing a computer lab once it has become old or obsolete. The revolving fund concept makes great sense, especially for large purchases, such as computers, that occur on a regular but non-annual basis. For example, consider a school system or school district with eight elementary schools that wants to support a computer lab of 25 stations in each school. It estimates that each lab's computers need to be replaced once every four to five years. The school district will have to establish a revolving fund of say the equivalent of $140,000 a year. This fund would then be used to completely replace the labs in two schools each year, thus establishing a 4-year replacement cycle and ensuring that each school's computing facility is filled with similar hardware, software, peripherals, etc. The labs would function more smoothly with fewer problems related to the difficulties of networking different computers with different capabilities. Schools would know exactly when the computers in their labs are to be replaced. Although capital spending across the eight schools would not be equitable on a year-to-year basis, equity over the lifetime of the computers in the labs would be maintained. This revolving fund approach could also be applied to the provision of professional development services and other school technology reform efforts that require one-time or non-annual expenditures.

Linking administrative and instructional technologies. Another approach is to provide a closer link between instructional and administrative uses of technology resources. For example, at the New American Schools project in Los Angeles, each teacher has been given a "creation station." The creation station is a laptop computer that has a number of instructional and instruction authoring programs to help teachers improve their day-to-day teaching and help them integrate technology into the curriculum (Espey, 2000; Johnson, 2012). The creation stations also contain student management software that teachers use to monitor student performance and attendance. Each station is linked to a central network in the school where the teacher uploads the routine student management information required by the school and district administration. By linking all of a teacher's responsibilities to the one computer, it is possible to keep track of teacher work, student progress and other matters related to district management.

Annual Operating Expenses

Another, and often overlooked, consideration in budgeting for technology is finding the funds and resources for the annual operating expenses of the systems that will be or have been put in place. Expenditures in this category include personnel to manage the technology system and repair the equipment, staff development, new software acquisition and updating, equipment replacement and parts for repair, potential costs for an Internet service provider, among others. To sustain these operating expenditures, the school district must have the ability to generate large amounts of new revenue on a continuing basis.

One solution is to train and equip one or more teachers to assume the management and upkeep responsibilities. Such teachers will have, as part of their incentive, limited teaching loads or responsibilities compared to regular teachers. They are encouraged to attend conferences and workshops to continuously update their knowledge and skills and be current with trends in technology, their uses and integration into school activities, and effective models for planning and

implementing technology professional development. Such teachers in turn plan and implement necessary technology professional development for other teachers and administrators on the use and integration of technology in various aspects of school activities. To support these responsibilities, administrators may need to adjust school schedules, teacher assignments, budget priorities, and substitute policies. However, in schools where the number of teaching personnel is determined by the pupil-to-teacher ratio, using teachers for ICT functions outside of the regular classroom has direct implications for everyone in the school, possibly leading to larger average class size. Consequently, it is important that school decision makers believe and convey to other members of staff that the benefits of a new technology and such arrangement outweigh the costs of larger classes for other teachers.

Cost-Saving Solutions

One cost-effective solution is the adoption of "webware"—a term that describes a broad range of bundled products and services that are provided over the internet, such as online banking, e-mail, school Web site management, electronic forms, online purchasing, virtual learning environments, parent-teacher conference scheduling, etc. Webware eliminates overhead cost and frees technology staff to focus on mission-critical systems and on the all-important human side: directly supporting teaching and learning (Doe, 2007; Raymond, 2010). It helps streamline common information management tasks, such as handling school forms. Its form builders enable nontechnical staff to put forms online in a way that eliminates paper, photocopying, printing, postage costs, envelopes, mailings and data entry by staff thereby resulting immediate and potentially significant cost savings. Several of these webware tools offer schools a way to realize immediate returns on this investment.

Another means for schools to prudently save on technology funds is to take advantage of the range of free, open-source technology options available. For example, in a 32,000-student Forsyth County Schools in Cumming, Georgia, USA, the district's chief of technology and information, saved $300,000 by replacing Microsoft Office with Open Office, free software available online that does much the same thing. The district also reviewed its software subscriptions to see whether some were duplicative or not being used. By doing this, a middle school math-simulation program that contained many of the same tools as a K-12 math program the district already had was let go, saving $55,000. There is also virtualization. Virtualization saves on equipment purchases and is very energy-efficient (Raymond, 2010). A typical PC requires 110 watts of electricity, while virtual computer can draw as little as a single watt. With virtual computers, it may cost less to heat computer labs since the machines don't run hot. Today's improved and more powerful virtual PCs, readily available virtualization software, and falling technology prices have allowed even rural and smaller schools to tap in to powerful technology equipment.

Sourcing Technology Funds

No funding organization wants to give away money to an institution with no vision (Lovitt, 2004). Thus, the only way to successfully and deservingly secure outside funding for ICT is through a clear vision of how those educational technologies will be used within classrooms and how those funds will jump-start and support school improvement initiatives (Abram, 2014). The first step is to establish an advisory group to develop a long-term technology plan. The group should be diverse, including administrators, teachers, parents, community members, students, and representatives from local businesses and colleges. This diversity creates an open forum for

sharing ideas and establishes a network to find out about funding opportunities. The next step is for the advisory group to develop a technology plan that will serve as a road map, establishing needs and setting parameters. An effective plan should cover a period of two to five years and include such components as infrastructure, hardware, networks, curriculum-related software, and student information systems, as well as technology training, service, and maintenance. The plan should focus on desired outcomes and the applications needed to achieve them, not on the technology itself. ICT goals should relate to student achievement and include an evaluation component to show a return on the investment.

Matching Needs to Funding Sources

Finding ICT funding begins with a review of the ICT plan to determine specific needs. The advisory group should generate and prioritize a list of needs related to student achievement before seeking input for possible solutions. With clearly defined needs and well-researched solutions, the advisory group is prepared to look for funding sources to match their needs. It is also helpful to prepare a funding profile of the school that includes the number of students, student characteristics (i.e., ethnic mix, number of students receiving free or reduced-cost lunches), and a description of the school's facilities and educational programs. ICT funding is available from two basic sources: reoccurring and non-reoccurring funding.

Reoccurring funding includes local and state taxes, bonds, or levies; school operating budgets; capital outlay for equipment or renovations; legislative formulas, such as Title I; instructional textbook funds earmarked for software or online content subscriptions; and district monies for maintenance and repairs. Non-reoccurring funding includes competitive grants and special funding opportunities, especially as they relate to school reform, innovative programs, and staff development; business and community partnerships; university, state, and private agencies; and parent and business donations.

The Power of Research

The group should begin the search for funding by tracking international, federal, state, local, and private funding sources. Utilize resources that monitor education legislation and identify government agencies, foundations, and other organizations (international and/or local) that make technology grants to elementary, middle, and high/secondary schools. The U.S. Department Education's Web site, www.ed.gov, is an excellent source for ICT funding information, although most of it is targeted for U.S. schools. UNESCO's Communication and Information Sector, http://www.unesco.org/new/en/communication-and-information/about-us/ provides information on strategies for government allocation of funding and international partners (non-profits and communication technology companies) who work to assist developing countries improve the ICT infrastructures. Here are some tips that can help to find private sector funding: ask staff, board members, and parents if they know foundation or corporate representatives personally; contact past donors in your school district; obtain access to the state foundation directory; and research the purposes and funding patterns of area foundations and corporations. Finally, consider submitting a grant application to a foundation after you receive federal and/or state funding to supplement your program. This will help strengthen the match opportunity and improve your opportunities for more technology funding. Schools should also consider the following avenues for external funding and support for school technology: technology levies, technology fees, and community groups and partnership donations.

Technology levies. Although levies allocated specifically for technology do provide other avenues for support beyond grants and bonds, they also carry the same major drawback--they are one-time allocations for technology, regardless of the number of years they may span. If planned well, these funds can jump-start technology-based school improvement efforts and initiatives. Without long-range planning, however, they allow the district to put off determining how they will fund those initiatives beyond the scope and timeline of the levy.

Technology fees. An increasing number of school districts are charging technology fee during enrollment or within specific courses that heavily utilize technology to help support the growing cost of maintenance and related consumables. These fees may vary tremendously depending on what they are designed to support.

Community, group, and partnership donations. Creating a greater sense of community can have its advantages, such as community, group, and partnership donations. Many of these groups hold fundraising activities throughout the academic year and are willing to support school improvement efforts. Most support the vision and benefits of educational technologies, and simply want to know their donations will go to a good cause. Donations can be anything from monetary hardware to professional development, depending upon the donor.

Managing Technology Funds

Develop local solutions and strategies for addressing critical areas within funding technology-based projects. These should be established early within the planning and development stages so that the information can be incorporated into the actual application of grants, bonds, and other funding opportunities. The solutions and strategies should cover hardware, software, infrastructure, maintenance and support services, and professional development.

Typically, hardware is the main focus of technology funding, and includes computer workstations and peripherals such as scanners and printers. In many cases it also includes fileservers, backup systems, and other behind-the-scenes equipment. Though they can vary tremendously within projects and among school districts, hardware costs usually make up approximately 50 percent of the overall technology expenditures (Johnson, 2012).

Software most often includes packages at the workstation level, but should also include those at the server level, like networking software and backup software. Traditionally, for every $10 spent on hardware, $3 or about 15 percent of the total budget will be spent on software for that hardware.

Infrastructure can be wiring (network and electrical) and/or networking components (such as switches, hubs, and routers). When a bond, grant, levy, or any referendum funds new building projects or additions, it is important to include the cost of technology infrastructure in the overall cost of the project. It should be assessed within any outstanding project, as major classroom alterations may be in order. A reasonable plan is to allow $1 (or possibly more, depending on the structure and age of your buildings) per square foot for technology infrastructure (Doe, 2007; Raymond, 2010). This will usually cover the cost of wiring, switches, and routers, although careful inspection and attention to details is critical. Because infrastructure costs are so

dependent on the current state and condition of the building, electrical status, composition of internal walls and ceilings, and many other factors, technology infrastructure is often set aside from the overall model of funding for technology.

Maintenance and support services must be included because of the fact that technology in schools is often outdated the very moment it is installed. What's worse, ICT will inevitably break down and need repairs. As such, maintenance and support services can be described as the repairs, upgrades, and services required to keep existing technologies in proper working condition throughout a reasonable lifespan. For every $10 spent on hardware, expect to spend an additional $2 on maintenance and support services, or roughly 10 percent of the overall total budget allocated for technology funding.

ICT-based professional development funding should be tied to the overall professional development program, but should not be bound by it. It is also a critical component of the overall funding process, as it is most often overlooked or underestimated by schools and districts. More projects are apt to fail and the blame aced on the technology itself, when the actual culprit is poor or inattentive planning. For every $10 typically spent on hardware, expect to spend another $5 on professional development for the hardware and software, accounting for up to 25 percent of the total budget allocated for technology funding.

Conclusion

Although gains have been made in the improvement of ICT resources in many school districts in Africa, the full impact of such gains has only been seen in a small portion of classrooms. This is due in part to administrative and organization factors at the district-level. Understanding the full range of costs associated with technology investments will assist school leaders in planning for the future. A number of guides to the technology planning process exist to help with these district-level decisions. An ICT planning committee should begin by identifying the school's or district's vision for learning, and then determine how technology can support that vision. After this, the committee should begin the process of needs assessment, goal setting, and action planning. The ICT plan should not focus only on hardware acquisition, resembling a shopping list of the latest fads, without apparent thought to integration into teaching and learning. Above all, curriculum and pedagogy must drive the technology plan and its uses in order to ensure that purchases will have long-term value in the face of constant price/performance improvements.

As schools procure ICT equipment and network them together, totaling the amount spent on hardware is merely the beginning of the total dollars needed for the effective use of the technology purchases. Such procurement cost is but one small part of the expenses schools can expect in subsequent years if they are going to effectively use those technology-based resources. Providing computers and software only through occasional bond measures leaves the technology vulnerable to breakdowns, obsolescence from lack of maintenance, and disuse from lack of staff training. It is important that school administrators, especially in rural school systems, should view ICT funding as a process rather than an event; utilize their technology plan as a road map; and use the power of research to match their needs with funding sources.

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