

Handheld Computing:
Thirteen Buttons for Understanding How to Integrate
Handheld Computers into Your School System©

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Every so often a new technology comes along that challenges our thoughts about what technology is supposed to be. These “paradigm shifting” technologies give us new ways of interacting with and using information. The personal computer is the last example that comes to mind thinking about devices that have fundamentally shifted our thoughts and culture. Handheld computers are the next machines that will change the face of our everyday lives. Indeed, these tiny computers are now becoming mainstream. Business people use them to keep track of critical information on the road. Doctors use them to take notes and keep abreast of the latest medical information. Senators use them to keep track of important contacts. Even the American Red Cross is using them to automate blood donations (Schwartz, 2000). The uses of handheld computers in education are just now being explored and invented.

Technology leaders need to think deeply about how this new technology can be used to enhance the learning, teaching, and leading of all people in schools. They need to understand that there are important issues which are inherent in new paradigms that must be addressed, and they need to have a systematic understanding for implementing handheld computers. The purpose of this article is to guide technology leaders on their journey of exploration and invention.

Handheld computers are at the fore-front of the fourth wave in the evolution of technology. To understand the phenomenon of first, second, third, and fourth wave changes in the evolution of technology, see Figure 1. Each of these waves of technological advances, ushered in new ideas of teaching and learning, about and with technology. The first wave of computers were large and expensive mainframes in engineering and business. They were used in education to do mostly administrative tasks so management of schools became better and easier.

The second wave of desktop computers in the late 1970s drastically changed the face of computing. These true "personal" computers gave individuals real computing power in small packages. At first, they were used mostly for programming

The Evolution of Computers and Technology Use

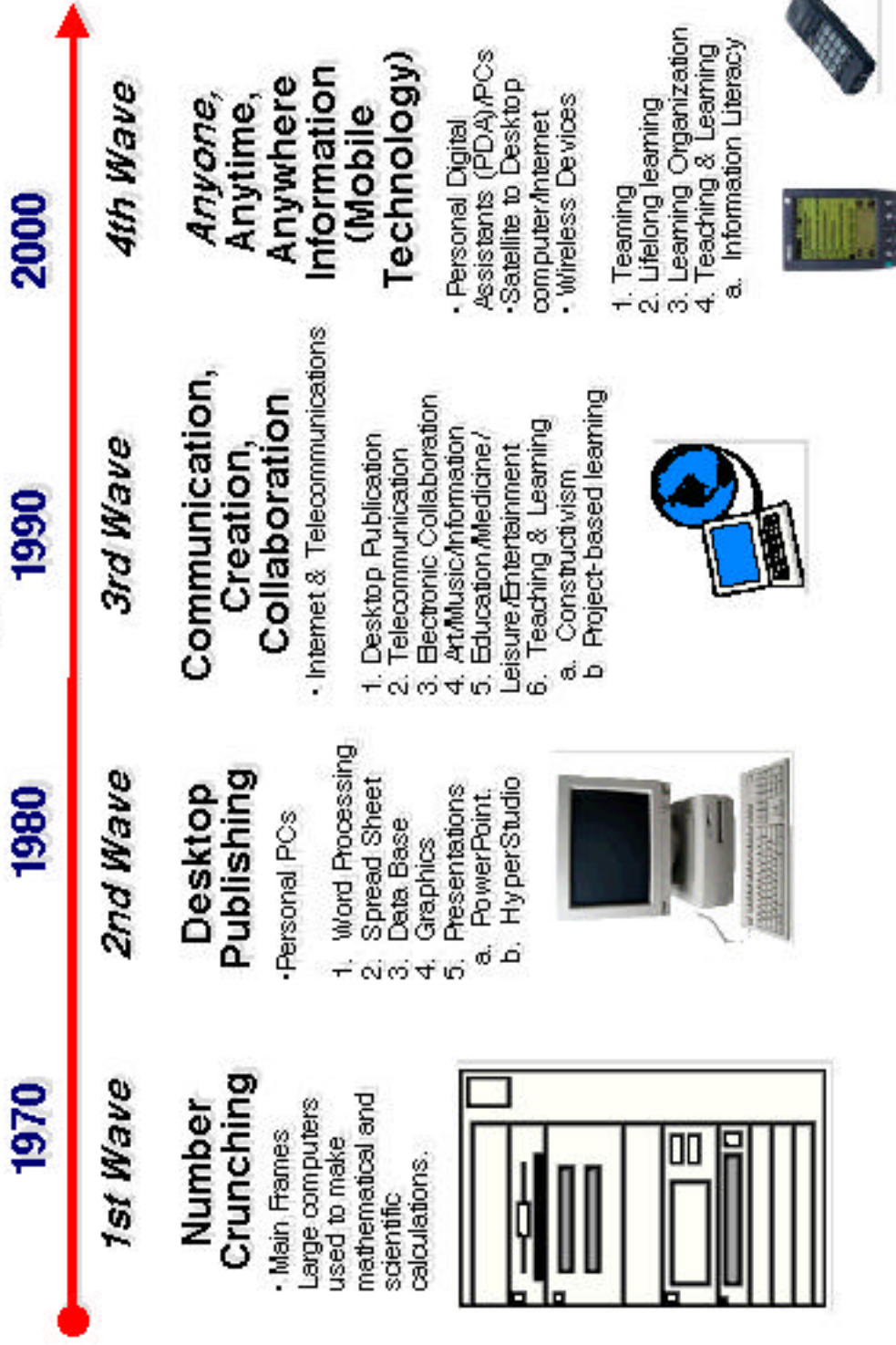


Figure 1

and number crunching, but as their processing power increased, their uses became more sophisticated. The idea of “computer literacy” in which students learned about the technology and how to use it flourished. The three functions of word processing, spreadsheets, and database soon became the standard uses of computers in schools and homes. Development of more powerful software allowed for the integration of graphics and gave publishers great page layout tools. As the processing power continued to increase, software designers were able to incorporate sounds and videos to create multimedia.

Then in the 1990s, the Internet and the World Wide Web made electronic publishing and communication mainstream. This third wave brought electronic communication, collaboration, and publishing to a new high. eCommerce thrived as more people used the Internet to buy goods and conduct business.

The fourth wave of technology is just beginning. The idea of “anyone/anytime/anywhere learning” is coming from the decreasing size of computers and new types of wireless connectivity. Very small computers which fit in shirt pockets, are able to do many information processing tasks that had formerly been done by desktop machines. These small computers are also known as PDAs (personal digital assistants), palmtop computers, or handheld computers. The Palm handheld computer (and PalmPilot) have been the most popular of the tiny computers. They were introduced in 1996 and now hold more than seventy percent of the market. Other makers of handheld computers that use the Palm Operating System are Handspring (which makes the Visor), IBM, Sony, TRG, and Symbol. There are other brands of handheld computers that make up the rest of the market including Psion and models based on the WindowsCE operating system. In 1998 there were 3.9 million handhelds sold with increases projected every year (Frauenfelder, 1999) By 2002, the number of handheld computers sold could surpass the number of personal computers sold. Handhelds are truly beginning to be seen as a tool and not a toy. The Palm's co-

developer Jeff Hawkins says that today's palmtop market "is a shadow of where it will be" in the future. (Frauenfelder, 1999, ¶7)

The historical understanding of the evolution of computing is critical to the success of integrating them into our school system. The roles and functions of the superintendent, board of education, teachers, and technology coordinators are seeing themselves as technology leaders. The fourth wave of computer technology must be viewed from a systems perspective by these technology leaders.

In the past, educational technology has been littered with failures. There have been programs implemented that did not give the desired results, computer labs that are infected with what McKenzie (1998) calls "screen saver disease," teachers who don't know how to use the computer on their desk, administrators that think only in terms of hardware and software, and curriculums that ignore the potential uses of technology.

Conversely, there have been many success stories of schools implementing technology. There are schools that have given teachers the technical and curricular support they need, students who are using technology to practice information literacy and develop authentic products, administrators who give needed support for technology, and communities that value and support the school programs.

So why are some schools successful while others are not? To be truly successful when implementing technology into schools, leaders must have a system perspective that encompasses all facets of the organization. Having this systematic view enables technology leaders to be aware of the pitfalls and stumbling blocks that could hinder or even cripple technology programs.

Imagine the following scenario; you have been searching for information relating to handheld computers and the issues that must be considered when integrating them into your school system. As you search the internet, a website emerges with thirteen buttons which are links to themes that must be considered when

integrating handheld computers into all aspects of your school system. The home page of the website shows thirteen buttons like this.



The thirteen buttons include: technology leadership, change, planning & organizing, staff development, infrastructure, technical support, teaching/learning, ethics, safety, security, curriculum, equity, and evaluation. The information on the homepage says that you are able to begin anywhere on the thirteen buttons. Under each button is a short description of the importance of handheld computers and issues related to integrating them in your school system.

While the information about all thirteen buttons of integrating handheld computers appears equal in importance, the website suggests that technology leaders start with the first button of leadership to get an understanding of how to proceed with planning, implementing, and evaluating handheld computers in your school system.

Leadership

Like other technologies, the amount and quality of leadership in the school is directly related to the success of the technology program. The leader has a vision of how emerging technologies can help all people in the learning organization become life-long learners and use those technologies for working with information. The leader knows that new paradigms require new thinking and different ways of looking at how things are done. Handheld computers bring with them much potential as well as new issues that need to be addressed. Leaders understand the complexities that are inherent with emerging technologies. For successful implementation, they need to understand how each of the buttons impact the others. Above all, leaders need to be effective models when using emerging technologies.

Guiding Questions:

- What is the role of the leader when integrating handheld computers into the school district (leadership, curriculum, teaching & learning, etc.)?
- What issues must the leader consider when moving toward handheld computers?
- What are the implications of mobile computing in a learning organization?
- Will the benefits of handheld computers be apparent to all leaders?
- What issues must be considered when focusing on handheld computers?
- Who should be using handheld computing devices?

Teaching and Learning

This is a critical button when thinking about integrating technology into schools. Often, the objectives of how students and teachers benefit from emerging technologies get lost in the jumble of the implementation process. Care must be taken to assure that this is a primary consideration.

What makes the handheld computer different from desktop computers in the

educational setting is that students can have true ownership in them. While lab or classroom computers may be available for students to use, they are still shared with others. A handheld computer on the other hand, can be a true "personal computer" to students. They can use the devices to practice information literacy by gathering, storing, and retrieving important information which is necessary for their own learning. Information literacy is at the heart of life-long learning and needs to be deeply incorporated into the school.

Handheld computers are like desktop computers in that they can be transformed by adding different software or hardware. They can be used as scientific calculators one minute, taking digital pictures the next, taking notes in class, or as scientific sensing devices. (Staudt, 1999) However, two factors that set handheld computers apart from desktop machines are price and portability. The prices of these devices currently range from \$150 to \$450 and will continue to become less expensive in the future. The portability of handheld computers is a major advantage over the desktop computer. They are very small and can be carried easily. This gives students the ability to take their computing with them from class to class and from school to home. Handheld computers are "personal tools of inquiry" that can be used anywhere. (Crawford and Staudt, 1999) It is this portability combined with the powerful data processing and flexibility of handheld computers, that make them a significant educational tool.

Teachers can use handheld computers for their own personal management tasks and teaming with others. They can share information and collaborate with administrators, other teachers, and students. There are management tools that can help teachers deal with the large amount of information in the modern classroom.

Guiding Questions:

- How can handheld computers be used in the classroom?
- Is the handheld computer a replacement for the desktop computer?

- What are the implications for teaching and learning with handheld computers?
- Will teacher use of handheld computers be different from students? How? Why?
- What are the best uses of handheld computing?
- What does the research say about handheld computing and student performance?

Staff Development

Jamie McKenzie (1998) gives three reasons why technology is not used to its full potential in schools. They are “lack of clear purpose, too little support for adult learning, and poor design of technology staff development.” Clearly, this view of technology integration emphasizes how important a sound and progressive staff development program is. Handheld computers bring with them new paradigms and new ways of thinking about information. Users of handheld computers need to have the resources available for success just as they did with desktop computers. Without quality staff development the potential of handheld computers will not be realized.

In a report that Greene (2000) notes, the second most important technological issue is “providing adequate support” for users. He states that schools are beginning to realize that the major challenges of technology are human factors. Getting staff and students to use emerging technology effectively is critical if the new technologies are to be used to their full potential. Although much of what people know about using desktop computers can be transferred to using handheld computers, there are still differences which pose roadblocks to users.

One of the most critical things that leaders must remember about support for handheld computers is that there needs to be a community of users who are actively involved in learning about and with handheld computers. Personal management can be a starting point for users. Most people could achieve this individually. However, a community of users gives the best support for raising the skill level of all those involved

and truly begin to use handheld computers as empowerment tools.

Guiding Questions

- What kind of staff development is necessary for handheld computers?
- Who should be responsible for staff development?
- Where should the staff development programs be held?
- When should the staff development programs be held?
- How should the staff development programs be organized?
- How important is staff development to the adoption of handheld computers?
- What elements of technology-based staff development are applicable to handheld computers?

Technology Support

We have seen with desktop computers that technology support is foundational to the implementation of technology programs. Handheld computers need to be kept in working condition and problems need to be fixed in a timely manner. Users come to depend greatly on their handheld computers and need to be confident that they will not be without their machines for long. It would be important for schools to have a few extra “loaners” that could be used in the event of major problems.

Another task of technology support is to make sure that users have access to help and information to use the handheld computers effectively. Help desks, online resources, and knowledgeable tech support staff are critical to a successful implementation. The most important time for support will be when the devices are introduced. Not only will users be the least knowledgeable, but bugs in the hardware, and software will need to be worked out.

Training for the tech support staff should not be overlooked. They are often trained mostly for desktop computers and may not have the training needed to effectively support handheld computers. Their skills should be at a much higher level

than typical users. They should have the necessary information and training as far in advance as possible before the handheld computers are deployed in the rest of the organization.

Guiding Questions

- Why is tech support so vital in handheld computing?
- Who should be responsible for tech support?
- Is tech support for handheld computers different from other types of technology?
- How are tech support personnel trained for handheld computers?
- Are there existing models that could be adopted to handheld computers?

V. Planning

Bailey, Lumley, and Dunbar (1995) assert that one of the major barriers to technology integration in schools is a lack of planning. A solid technology plan is critical for the implementation of any technology in schools. This can be accomplished using their six step model. The model's steps are: (1) organize and empower a district technology planning team, (2) prepare the planning team for the study, (3) assess the current state of technology in the district, (4) develop guiding documents for technology, (5) develop a long-range technology plan, and (6) implement and institutionalize the technology plan.

While planning, leaders need to be aware of emerging technologies that will need to be incorporated into their planning. Handheld computers will be one of the most important of those technologies in the near future. Much is now being learned about what they can do and how they can help students learn. There needs to be a systematic approach for implementing handheld computers using appropriate planning techniques.

Guiding Questions

- How should school districts plan for handheld computers?

- Who should be responsible?
- How often should planning be done?
- Why is planning so difficult?
- Should handheld computers be incorporated into the regular school plan?
- Is planning done at the district level as well as the building? Why?

VI. Infrastructure

Infrastructure refers to the physical needs and aspects of technology.

Although handheld computers are inexpensive to purchase, there are many issues with regards to what other expenses will be incurred along the way. Peripherals such as keyboards, cameras, cases, styli, hardware modules will need to be purchased. Decisions about who needs what equipment will need to be made. Software will also need to be added and upgraded as is so often needed. Although some software is free, high quality commercial products are often a better value in the long run.

Networking handheld computers will become an important aspect of their use. This will add more power to how they can be used, but also adds new dimensions to the issues of how they are integrated into the schools.

Guiding Questions

- What kind of infrastructure is necessary to make handheld computers work?
- Is there a need for a new infrastructures in handheld computers?
- What barriers exist in the infrastructure that will hamper the development and use of handheld computers?
- What should new facilities look like to accommodate handheld computers?
- Where does funding for handheld computers come from?

VII. Safety

It is well known that spending many hours at desktop computers can result in

eye strain and repetitive stress injuries such as carpal tunnel syndrome. There is also the exposure to EMFs which may affect a person's health. So, do handheld computers have risks also? It is clear that the small screen on handheld computers may affect some users who have weak eyesight. Using handheld computers for too long may strain the eyes. There are new screens now that are color which gives a better contrast and helps people to see the screen without straining. As the screens get better, some of this problem will go away.

Another issue with the tiny devices is the need for small motor movement and precise placing on the stylus. This may lead to hand cramping in some people and make the device uncomfortable to use. There are ways to deal with this such as buying a larger stylus which allows for more natural hand positions or keyboards that limit the amount input by pen. Little is known about the impact that handheld computer use has on students. Leaders need to keep this issue at the forefront and make sure that the technologies that are helping to develop the mind are not hurting the body.

Guiding Questions

- What are the safety issues when using handheld computers?
- Is eye strain a problem?
- Is carpal tunnel syndrome a problem?
- How are the safety issues different from other types of technology?
- Are young students at risk developing problems over time?

VIII. Ethics

All new technologies bring with them new ethical questions and handheld computers are no exception. They have the ability to beam information to other handheld computers through an infrared port (like remote control devices). This raises the question of cheating in schools. Students will have the ability to share notes easily and have a great deal of information stored for easy access. The ability to share

information is critical to teaming activities and gathering, storing, and retrieving information is critical to information literacy. Unfortunately, traditional models of classrooms will not be conducive to these new devices.

Like all computers there are many games that can be played on them. Technology leaders will need to evaluate what role, if any, games play in the implementation of handheld computers. It could be argued that some games are learning tools. How do teachers deal with students who seem to be taking notes when they are actually playing a game? Above all, schools should have in place a curriculum that incorporates digital ethics. Administrators and teachers need to be models that show students the highest level of ethics with all technologies. Without forethought and planning, the devices could be seen as more of a distraction than a learning tool.

Guiding Questions

- What are the ethical issues that need to be addressed in handheld computers?
- How have schools addressed these ethical issues so far?
- What is likely to happen if Acceptable Use Policies and Digital Citizenship Curriculum are not taught?
- How can ethical behavior be demonstrated by leadership when using handheld computers?

IX. Evaluation

As with all educational programs, it is important to evaluate the effectiveness of technology integration. This evaluation provides important feedback that can help determine how well the technology is being used and if its an effective teaching and productivity tool. In general, schools have not done a good job of evaluating technology in the past. This needs to change if schools are to continue spending large amounts of money. Many stake holders are becoming disillusioned with money being

spent without accountability.

Johnson (1996) contends that there are three major uses of educational technology: enhancing professional productivity for administrators and teachers, automating and enhancing instruction for students, and as an information processing and productivity tool. Using handheld computers in these areas will require different forms of evaluation. Johnson notes how difficult it is to evaluate technology use. It does not lend itself well to quantifiable scores on national, standardized tests. Schools need to look at what evaluation techniques are best suited to their situation and the outcomes that they have set for themselves.

Guiding Questions

- How do you evaluate the effectiveness of handheld computers?
- Is evaluation different from other forms of technology evaluation?
- What kind of assessment measures are available to determine the effectiveness of handheld computers?
- What should we be evaluating when considering handheld computers? (e.g., student achievement, faculty effectiveness, faculty efficiency, student productivity)

X. Security

Technology is an expensive undertaking and one that needs to be protected. Schools have taken many different steps to secure equipment, data, and networks. Handheld computers will add many new aspects to the issue of security. While desktop computers can be locked in rooms and labs, handheld computers, by their very essence, are mobile and intended to be taken everywhere. This leaves them susceptible to damage and theft.

All computers are vulnerable to destructive programs such as viruses, worms, and trojan horses; handheld computers are no exception. While currently these are not problems for handheld computers, they will certainly be in the future.

The types of data that is stored on handheld computers is as diverse as the users. Some of that data, especially on teachers and administrators devices, may be sensitive in nature. If the person's handheld is lost or stolen, the private data could become available to others.

Another issue that handheld computers introduce is the need for users to understand how to get information from the handheld computers onto the desktop computer and back without losing or overwriting data. This "syncing" process has been automated a great deal but there is still a chance that users will inadvertently delete some or all of their important information.

Guiding Questions

- What security issues are present with handheld computers?
- What can leaders do to enhance security when using handheld computers?
- Is theft an issue? Is misuse of information an issue?
- How do you balance security with maximum accessibility of handheld computers to all people in a school district?

XI. Curriculum

Schools are being held more accountable for student performance on standardized tests. Curriculums are changing to represent the knowledge-base needed for the students to do well on these assessments. Depending on the school's vision of how technology relates to what they are wanting to accomplish, handheld computers may have no more of a role than other devices such as calculators. In other schools they would play a major role in helping students practice information literacy as an active part of their information needs.

Looking at where handheld computers fit into the current curriculum can help leaders determine what the present functions of handheld computers can be. But more importantly, leaders need to have a vision of how handheld computers can empower

students in a transformed and technology-infused curriculum.

Guiding Questions

- How does or will the handheld computer impact the curriculum?
- What kind of curriculum materials can handheld computers hold?
- Where does the curriculum focus on with handheld computers?

XII. Change

We have learned from past experiences that often the implementation of new technology is difficult because of the change involved. There are many barriers that can keep people from adopting a new technology. Sandholtz, Ringstaff, and Dwyer (1997) state that a lack of access, support, and time are three main barriers which make it difficult for people to adopt new technologies. Fullan (1991) proposed that people do not know how to cope with change and so tend to resist it. Leaders need to be aware of the change process and how to help people understand and embrace it.

Using handheld computers will take a different mindset than what people are now used to with desktop computers. Even though they are still computers, there is a significant paradigm shift when moving to anytime/anywhere information. Handheld computers ask that the user think about how they use information and to determine how they can best build their own mobile databank. They will change the way that users access, collect, transfer, store, categorize, and find information.

Up to now, handheld computers have been thought of as “just electronic organizers.” This is far from accurate. Technology leaders will need to make sure that users see that these devices are not just electrifying the past but blazing new trails.

Guiding Questions

- What do we know about change and handheld computers?
- What are basic concerns in handheld computers?
- How will handheld computers impact our personal and professional lives?

- What can the school leader do to facilitate the change process with respect to handheld computers?

XIII. Equity

There has been much debate lately about the “digital divide.” Larry Irving (1999) states that it is the “divide between those with access to new technologies and those without.” According to Irving the digital divide is “one of America's leading economic and civil rights issues.” Access to technology varies greatly depending on several factors including money available, geographic area, and leadership in educational technology.

Schools that are in affluent areas tend to have better technology. They are supported by the community and encouraged to use technology in all facets of education. Schools with fewer financial resources are at a disadvantage when it comes to buying, learning, and using technology. Also of concern to educators is the “skills divide.” This is a symptom of the lack of technology in which students do not have the skills necessary to use technologies. The power of handheld computers combined with the low cost will help to get technology into the hands of students who might not normally have access to technology.

Guiding Questions

- How does a school know if there is a digital divide?
- What is causing the inequity?
- What practices can help to bridge the divide?
- Can handheld computers help close the gap between technology haves and have nots?

Conclusion

While the issues in the thirteen button model appear to be static and segmented, most technology leaders find that this is not the case. The button metaphor provides a way for technology leaders to understand the system, but they also recognize that the issues are dynamic in nature. The issues “pulsate” depending on the school district’s situation. Each issue grows in significance as the need arises and recedes as it is resolved or eclipsed by others which have become more pressing.

For example, when first thinking of implementing handheld computers into a school, the leadership and planning buttons come to the forefront. As the planning process matures, other buttons also become important. The teaching/learning, curriculum, and evaluation buttons help leaders to understand how the new technology will be used and evaluated. Once leaders have a good idea of what handheld computers can do in their school, buttons such as infrastructure, staff development, and tech support come into focus and take on new importance. These buttons help determine what devices and peripherals to buy and how to build the all important support system.

All of the buttons will continually increase and decrease in significance. A school may find that some of their students are misusing the devices and need to look at how to deal with ethical issues. There may be safety concerns for eyestrain with young students or security concerns when students break or lose their handheld computers. In other situations where schools have funding problems, they may need to be aware of equitable distribution when implementing handheld computers. And, like implementing any emerging technology, the user’s ability to change and adapt is crucial for success. It is critical that technology leaders understand the complex and interactive nature of the buttons.

Dr. Mary Hatwood Futrell, Dean of the Graduate School of Education at George Washington University, said that “[w]e must look at schools as a vehicle for making

sure people are able to use the tools of our society." If technology leaders believe this, and truly want to empower all people in our schools with handheld computers, then they must have a proactive vision about the technology. This vision can then be supported by leaders who understand how important it is to look at the integration of handheld computers as a system in which all parts impact and interact with each other. This systems approach provides a framework that can give direction and guidance for leaders in these times of turbulent and significant change.

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