MAY 2005

Assessing the Impact of IT-Driven Education in K–12 Schools

Ganesh D. Bhatt
Associate Professor
Department of Information Science and Systems
Morgan State University

Special Report Series

IBM Center for
The Business of Government

SPECIAL REPORT SERIES

Assessing the Impact of IT-Driven Education in K–12 Schools

Ganesh D. Bhatt
Associate Professor
Department of Information Science and Systems
Morgan State University

May 2005

IBM Center for
**The Business
of Government**

TABLE OF CONTENTS

FOREWORD

May 2005

On behalf of the IBM Center for The Business of Government, we are pleased to present this report, "Assessing the Impact of IT-Driven Education in K–12 Schools," by Ganesh D. Bhatt.

Return on investment (ROI) considerations in K–12 education are new and evolving. In the 1980s after the issuance of the report *A Nation At Risk*, school districts scrambled to respond to the inadequacies identified. The education establishment unleashed new programs, teacher salaries increased, per-pupil spending increased, and public expectations for public education increased. The results of these responses were mediocre at best. The missing element was the investment in programs that had proven success rates. In fact, school district leaders didn't know how to assess return on investment and had no methodology for analysis. Perhaps most importantly, the culture of the education establishment in America was unwilling to accept this "private sector" type of business analysis.

In the late 1990s, school districts raised standards in an effort to demonstrate rigorous academic change. Again, the essential consideration for success, allocating vital resources to programs that have demonstrated success, was elusive. To be sure, some school districts and states began to assess spending efficacy as tax rates increased and the recession of the early 2000s took hold. With scarce funding and the failure of additional investments in the 1980s and 1990s to increase student test scores, as well as greater student needs, the time had arrived for serious consideration of which programs worked at what costs—return on investment.

The analysis of ROI in education is fundamental in the management philosophy and application of data-driven decision making. School leaders must know which programs deliver the biggest value for the dollar spent in order to target funding where it is needed most. As this report was being written, most school districts across America continue to make decisions on spending in a void—without consideration of what learning gains will be realized from each taxpayer dollar invested. Yet, with the advent of data-driven decision making and public pressure on funding streams, school district leaders are demanding to know how investments will increase—or facilitate an increase in—student achievement.

This report details a methodology that may be used to assess educational return on investment, in particular in the area of technology investments. School leaders must take ROI into consideration before allocating taxpayer funds to technology and other program support materials. A process for gainfully considering ROI is investigated and used effectively in this report.

IT spending in school districts is more than just hardware and software; it should be targeted spending to achieve measurable learning results. This report begins to tackle this challenge and drive the discussion of IT spending toward achievable ROI. We trust that it will be helpful and useful to school administrators and teachers across the nation as they continue to address this important question.

Paul R. Lawrence
Partner-in-Charge
IBM Center for The Business of Government
paul.lawrence@us.ibm.com

Robert M. Barthelmes
Education Industry Leader
IBM Business Consulting Services
rbathel@us.ibm.com

EXECUTIVE SUMMARY

Technology has always been a vital part of human civilization. At the present time, however, the use of technology, especially information technology (IT), has become pervasive, affecting almost every human activity. As a growing number of researchers and policy makers are realizing that IT can have profound effects on our educational systems, many educational institutions are using IT to standardize, deliver, and create instruction. In addition, some institutions are replacing face-to-face interactions between teachers and students through computer-mediated systems.

Even after realizing that IT plays a pivotal role in the education system, there are serious concerns among educational scholars and other community leaders about the effectiveness of IT in education—especially for K–12 schools. There are three reasons for these concerns. First, for more than two decades, it has been widely known that IT per se is of little use if it is not managed properly. Second, economists and the research community find difficulties in quantifying the returns from IT investments for K–12 schools. Finally, some policy makers and community leaders believe that for K–12 schools, technology often begins to dominate instruction and learning, thereby defeating the very purpose of education. Therefore, it becomes essential for school administrators and policy makers to carefully evaluate the mission, objectives, and strategies of their school before embarking on the application of IT-based instructional projects. Moreover, in implementing such projects, the policy makers and administrators must carry out a thorough assessment of the learning goals and outcomes. In the absence of a coherent alignment between educational strategy and IT strategy, the effects of IT-based instruction for the school are likely to be negligible.

The main aim of this report is to address the effects of IT-based instruction on K–12 schools and devise a set of meaningful indicators for measuring the return on IT investment for schools. Our research sample consists of a group of 20 students, teachers, and principals involved in IT-based educational initiatives at K–12 schools in the state of Maryland. The sampling frame was selected at the local school level rather than at the state level, because the key stakeholders—students, teachers, and principals—can provide a better assessment of the IT-based instruction at the schools than the policy makers at the state level. The students, teachers, and principals are directly involved in the process, while policy makers often draw broad normative conclusions about the effects of IT on the educational system.

Although the current report specifically focuses on K–12 schools in Maryland, the findings presented will be fruitful for K–12 schools in other states that are planning to assess the effectiveness and competitive potential of IT-based instruction.

Introduction

Organizations have traditionally used IT for automation purposes; however, IT is increasingly now being used for "informating" as well as transformation purposes. A plethora of recent research suggests that the use of IT for automation does not offer any significant competitive advantage to the organization, *unless* it is carried out in conjunction with widespread changes in organizational structures, policies, and processes that are required to capitalize on IT capabilities. Therefore, the main issue for organizations becomes understanding the strategic potential of IT for competitive advantages (Ehrmann, 1989; Zuboff, 1988).

Seeing that IT can be used for automation purposes, a number of educational system administrators showed considerable interest in catering to the educational needs of busy, full-time working adults through distance education. The main motivation of these institutions was limited to automating the preparation and delivery of instructional content for the students.

A note about terminology: In this report, the terms *technology* and *information technology (IT)* are used interchangeably, even though *technology* is the broader term. *IT-based instruction* involves teaching in which a significant part of the instruction is prepared and delivered through the use of computer hardware and software. Typically, IT-based instruction makes use of instructional databases for accessing and presenting instructional material through text-only, audio-only, text-audio, text-graphics, and/or a combination of text, audio, and graphic multimedia. Presently, the growing use of the Internet has offered teachers the flexibility to customize instructional material and match different kinds of presentation media for meeting students' personal educational needs.

The concept of distance learning did not gain much popularity in the United States until the 1990s. But with the rise of the Internet and multimedia technologies, the practice of distance learning is gaining momentum. Although the practice of distance learning is useful for working adults, its potential for students at K–12 schools is not being explored in detail. Because the main aim of educating through distance learning centers on the automation of instructional content, it is the opinion of this author that the use of IT for automation will not provide any significant value to the stakeholders at K–12 schools. Rather, the aim of the K–12 schools should be to capitalize on the *strategic potential* of IT so that they generate and deliver significant value for the stakeholders.

The results of studies examining the strategic potential of IT-based instruction for K–12 schools are mixed. For example, Bednar, Cunningham, Duffy, and Perry (1992) argue that IT has significant potential in enhancing the quality of instruction. They posit that the use of simulations and IT-based interactions can provide students a better understanding of the behavior of a complex object. Moreover, IT allows students the opportunity to gain access to educational material outside of their school library. Davey (1999) sees immense potential in the use of the Internet, bulletin boards, and chat rooms to allow direct and timely interactions between students and teachers at the K–12 level. Similarly, Valdez, McNabb, Foertsch, Anderson, Hawkes, and Raack (2000) note that successful implementation of technology can have significant impact on the quality of education—through close interactions between teachers and students.

Some studies have looked beyond academic skills in identifying the role of IT-based instruction. These studies indicate that IT-based instruction enhances student motivation, self-confidence, and self-esteem (Sivin-Kachala and Bialo, 2000). These intangible traits are considered critical for the future success of the students.

On the other hand, LeFevre's (1999) findings show that IT does not provide long-term remedies for the educational system. According to LeFevre, the biggest stumbling block that some schools encounter is the lack of resources required for the implementation and maintenance of IT, because funding technology is an expensive endeavor for schools. Moreover, schools are required to pay for continued upgrading of equipment and technology so that they can keep up with technological advances. Second, IT-based instruction requires teachers trained in the use of technology. In the absence of teachers trained in the application of technology, IT-based instruction is likely going to be ineffective. Wenglinsky (1998) takes a somewhat different view in reporting that black and Latino students, as compared to white and Asian students, lag significantly behind in tasks that involve computer simulations and require higher-order thinking. He argues that that fact does not clearly support the notion that technology-based educational instruction is superior in quality to instruction that is delivered traditionally by teachers in a classroom setting.

To resolve these contradictory findings, this study was conducted at the school level to provide a better and rich assessment of the effectiveness of IT-based instruction. The goals for the study were twofold: (1) to critically examine the effectiveness and benefits of IT-based instruction; and (2) to devise meaningful indicators for measuring the return from IT investment in K–12 schools.

Scope of the Study

The main focus of this report is to describe the current status of IT-based instruction at K–12 schools in the state of Maryland. The report examines the benefits, challenges, and problems of IT-based instruction faced by K–12 schools in Maryland. Though the description of the effectiveness of IT-based education and indicators for measuring the return from IT-based instruction for K–12 schools is limited to Maryland, these findings can provide substantial guidelines to policy makers across the country to understand how IT-based instruction can be integrated with the mission, objectives, and strategy of schools and how K–12 schools can gain returns from their IT investment, undertaken for instructional purposes.

Background of IT-Based Instruction in Maryland

In the mid-1990s, Maryland embarked on a path for the effective utilization of technologies for its K–12 schools. Over the years, K–12 schools have gained considerable expertise in utilizing IT infrastructure for educational purposes. However, the state is facing several challenges that arise from the islands of disparate IT systems. For example, presently, Maryland has three kinds of disparate systems: legacy systems, newer systems, and those acquired specifically for instructional purposes. Integrating these systems has not been easy. The state is also facing problems in creating and acquiring useful "digital contents" that could be used to challenge students in the areas of problem solving, creativity, and higher-order critical thinking (Willis, Thompson, and Sadera, 1999).

In a recent three-year plan for 2002–2005, the state defined its core vision in the following terms:

> Improved student learning will be achieved through the seamless integration of technology into Maryland Schools. The use of technology, and the digital contents that it brings, will create dynamic and challenging learning environments that engage and motivate our students, enabling all to be independent, competent and creative thinkers, and effective communicators and problem solvers. In addition, improved planning, monitoring and productivity will result from the use of information systems by teachers and those who administer and manage classrooms, schools and school programs. (Maryland State Department of Education, 2002)

In order to achieve this vision, the state formulated five objectives (Maryland State Department of Education, 2002):

- Universal access to technology
- Hiring of technology-savvy teachers who can effectively integrate technology into their classrooms

- Seamless integration of technology and digital content into all classrooms for challenging students' critical thinking
- Integration of technology in school administration and operations
- Continuous improvement in the use of technology for instructional purposes

Although these objectives are exemplary for enhancing the quality of education, there has been a dearth of studies that clearly describe the achievements and challenges that schools at the state level are currently facing (for example, Sveiby, 1997).

Outcomes of the Study

One of the primary outcomes of this study is to provide a more realistic understanding of IT-based instruction for K–12 schools in Maryland. State officials often look at broader issues with a normative lens, without recognizing the implications of their conclusions at the local school level. Therefore, it becomes imperative that in order to get a fair assessment of IT-based instruction, one needs to conduct research at the local school level. This study does so. By focusing at the school level, the research findings provide a better description of the benefits, challenges, and problems faced by school administrators in preparing and delivering effective IT-based instruction to students.

Second, this study devises a set of indicators for measuring the contribution of IT-based instruction for K–12 schools. A basic framework to measure both the financial as well as non-financial returns from IT investment, undertaken for instructional purposes, is provided. A thorough understanding of the returns from IT investment is likely to offer policy makers broad guidelines in the implementation of IT-based instructional projects (Sveiby, 1997). Finally, recommendations are offered that briefly explain how K–12 schools can effectively utilize IT-based instruction and how they can measure the returns from their investment in IT-based projects that are undertaken for instructional purposes.

Defining IT-Based Instruction

In the traditional educational system, technology played a supporting role in clarifying instruction and creating a learning environment. For example, audio and visual systems have traditionally been used to supplement instruction and enhance learning in the schools. However, presently, technology has become an integral part of the education system, and IT-based instruction is increasingly being used to replace traditional instruction. In addition, face-to-face interactions between students and teachers are being substituted with computer-mediated interactions.

For instructional purposes, two types of IT applications typically are used: computer-aided instruction (CAI) and computer-managed instruction (CMI). CAI is a more mechanical process in which students interact directly with the computer that controls the instructional material and provides feedback to the students. Drill and practice software are examples of CAI. On the other hand, CMI is used to augment and complement teachers in managing their instruction and instructional material. Cognitive Tutor software such as Carnegie Learning's problem solving and simulation software for decision analysis are examples of CMI (Heinich, Molenda, and Russell, 1993). Leidner and Jarvenpaa (1995) provide a comprehensive scheme of IT-based instruction and related pedagogical assumptions as shown in the Appendix.

Differentiating between CAI and CMI is becoming difficult, because teachers are increasingly using integrated IT systems, encompassing both CAI and CMI—audio, video, computers, and multimedia—for preparing and delivering instructional material to students. Communication tools such as e-mails, networking, and online discussions and chat rooms have flourished, allowing students and teachers to collaborate and share information.

By recognizing that IT-based instruction can be substituted for traditional instruction, a growing number of schools are advancing the concept of "learning networks" composed of computers connected through some shared databases developed for educational purposes. These networks provide students opportunities to acquire and analyze real-world data and interpret their properties. In recent years, with the growing popularity of the Internet and graphical user interfaces (GUI), technologies that contain hypermedia solutions, simulations, and decision support capabilities are increasingly being used to enhance student learning.

Defining Learning Theories

Instruction and learning are intertwined. *Instruction* refers to the arrangement of information that facilitates learning (Heinich, Molenda, and Russell, 1993: 4); *learning* refers to the acquisition and application of new knowledge, skills, and behavior. The instructional tools that teachers use encompass a whole range of methods, media, and means that help guide the learner's study. The research has broadly defined learning theories in the following three categories.

Behaviorism

Behaviorism focuses on objectively observable behaviors and does not emphasize the role of mental activities. According to behavioral theorists, learning is nothing more than the acquisition of new behavior. Thus, behaviorists identify conditioning as a universal learning process (Skinner, 1976). This theory is simple to understand because it relies only on observable behaviors.

Cognitivism

Cognitive theorists argue that a large part of learning takes place through the reshaping of mental schemata. Like behaviorism, cognitivism acknowledges the importance of reinforcement, but stresses the role of feedback about the correctness of the responses (Piaget, 1990). This approach argues that meaningful information is easier to learn, remember, and assimilate.

Constructivism

Constructivists argue that learners construct their own reality based upon their perceptions and experiences; therefore, knowledge becomes a part of personal experience, mental structures, and beliefs that are used to interpret objects and events (Vygotsky, 1962). Constructivists do not ignore the objective, physical world, but they argue that much of the reality is construed, interpreted, and shared through personal experience and self-interpretation.

Learning Theories and IT-Based Instruction

In addressing the question of the relationship between learning and instructional design methodologies, the importance of learning theories becomes evident. For example, both behaviorism and cognitivism are governed by an objective view of knowledge, so instruction becomes the chief means of transferring knowledge from teachers to students.

Designing instruction from a behaviorist or cognitivist perspective is simple and straightforward, because the teachers analyze the task at hand and set the learning goals and outcomes. In order to deliver instruction effectively, the teachers decompose complex tasks into meaningful chunks that students can memorize and absorb mentally. The instructors decide the importance of the subject area and the content to be covered for the students (Jonassen, 1993).

On the other hand, according to constructivism, knowledge is considered relative, and is construed and shared through personal experience and mental schemas. Therefore, in designing instruction from a constructivist's perspective, teachers become more like facilitators rather than controllers of the knowledge transfer. In this perspective, the aim is for students to take initiative in learning and knowledge discovery. Thus, the content of the instruction is not pre-specified; the direction and pace of learning are governed by the students (O'Loughlin, 1992).

These arguments can also be used for the preparation and delivery of IT-based instruction for K–12 schools. From a behaviorist/cognitivist perspective, the main purpose of IT lies in automating most teacher-centered instruction. From this view, not only is instructional material broken down into standard digital modules, but also instruction is delivered through communication systems. In extreme cases, meaningful face-to-face interactions between students and teachers are replaced through computer-mediated interactions. Although not every activity is amenable to automation, in the behaviorist/cognitivist perspective, attempts are made to transform unstructured educational activities into standard sets of routines that can be captured and delivered through IT.

Irrespective of the application of technology in the instruction, the teachers maintain control of the content and the pace of the instruction. This is because the main purpose, according to the behaviorist/cognitivist perspective, is the transfer of knowledge from teachers to students. By structuring digital modules in specified standard ways, the teachers attempt to organize knowledge coherently so that students can mentally grasp chunks of the subject material in a meaningful way.

From a constructivist approach, the main function of IT-based instruction is to create an environment that engages students in self-learning, knowledge discovery, and creativity. The use of hypermedia, which allows students to jump on various topics nonlinearly, and the application of simulation, which provides students opportunities to look at and observe a design from different perspectives, are considered effective kinds of IT instructional methods from a constructivist approach.

It is the opinion of this author that there should not be a "separation" between the behaviorist/cognitivist and the constructivist approach in delivering IT-based instruction to students at the K–12 level. Rather, it is argued here that IT-based instruction should be prepared and delivered by recognizing the importance of all three approaches in parallel. Though the behaviorist/cognitivist perspective offers useful guidance in structuring information into meaningful chunks, it also restrains students' self-discovery and self-reflection. On the other hand, although the constructivist perspective is conceptually sound, a self-paced learning and knowledge discovery approach may not be most suitable for all students at K–12 schools, because a majority of students do not necessarily know the foundation, importance, and relevance of the subject material.

A meaningful way for making IT-based instruction more effective would be to apply the behaviorist/cognitivist approach as well as the constructivist perspective in steps. From grade 6 to grade 10, IT-based instruction should be prepared from the behaviorist/cognitivist perspective. Structured and organized digital content often encourages students to strive to do their best, and teachers can carefully monitor students' performance. Beyond grade 10, IT-based instruction can be prepared according to constructivism theory, because at this level students begin to show curiosity and interest in different areas of the subject material. Therefore, IT-based instruction from a constructivist approach is likely to offer students the opportunity to locate and reflect on information. Even with the use of this approach, occasional guidance and direction from instructors is critical so that students do not simply wander around in the technological arena of voluminous databases.

This approach is similar to that of Culp, Hawkins, and Honey (1999), who posit that while drill and practice software are used for rote learning, integrated software can be used to organize and analyze information for solving and interpreting complex problems. Therefore, the main issue becomes ensuring that students are offered customized IT-based instruction to match their skills.

This report builds on interviews and informal discussions from a group of 20 students, teachers, and principals involved in IT-based initiatives for K–12 schools in Maryland. The interviews were held informally, because the main purpose was to understand local stakeholders' views about the effectiveness, challenges, and returns from IT-based instruction in their respective schools (Kerr, 1994). Interviews were transcribed and analyzed based on the core themes. Where ambiguities existed, follow-up informal discussions were carried out for further clarification of the stakeholders' views.

Findings

Teacher IT Training and the Effectiveness of Instruction

Finding 1: Faculty training in the application of IT will positively affect the effectiveness of instruction for K–12 schools.
Based on the interviews and discussions with teachers, students, and principals, it was found that almost all faculty members, students, and principals agreed that "technology" in itself is not a magic wand to increase the effectiveness and quality of education in schools. The use of IT for instructional purposes is important, but mere availability of IT does not automatically lead to better education and critical thinking. To realize the benefits of technology, having technologically knowledgeable and skilled teachers is crucial. Only trained teachers are in a position to create useful digital content and deliver it efficiently to students.

Despite the fact that faculty training is an important component of IT-based instruction, the state of Maryland has not paid much attention to it, because training requires investment. As one principal recalled, "Although Maryland is making huge investments in the acquisition of IT for instructional purposes, it pays scant attention to faculty and student training. Because training is an intangible concept, policy makers consider it as an administrative expense rather than a part of the IT investment." This point was further elaborated by another principal: "This means an investment must be made by schools in faculty training. However, the limited resources and budget that we receive is spent in maintenance and upgrading of the systems. Training is always on our agenda, but it never gets priority."

Despite the fact that teachers are challenged to gain expertise in the use of technology for instructional purposes, they have not been provided sufficient resources and incentives for training. Teachers report several issues that present barriers to their use of educational technology. Some of these issues relate to release time for professional development and for learning how to use computers and apply the technology.

Major Findings

1. Faculty training in the application of IT will positively affect the effectiveness of instruction for K–12 schools.
2. A proper combination of IT-based instruction and traditional instruction will positively affect the quality of learning for K–12 students.
3. A technology-integrated curriculum will positively affect student engagement in learning.
4. A proper combination of IT-based instruction and traditional instruction will positively affect the competitiveness of K–12 schools.
5. A proper combination of IT-based instruction and traditional instruction will positively affect the return on IT investment for K–12 schools.
6. IT-based instruction, when properly combined with traditional instruction, will positively affect students' learning and knowledge.
7. A proper combination of IT-based instruction and traditional instruction, accompanied by the restructuring of existing work practices, will have a positive effect on the quality of instruction for students.
8. A proper combination of IT-based instruction and traditional instruction for students will have a positive effect on the growth of K–12 schools.

The results of this report are similar to those of Coley, Cradler, and Engel (1997), and Silverstein, Frechtling, and Miyoaka (2000), who posit that to deliver instruction effectively, teachers must have training in the use of technology for instructional purposes. Statham and Torell (1999) argue that teachers typically receive little training in integrating technology for instructional purposes, thereby lowering the standard of instruction. Seeing the importance of training, Wahl (2000) suggests that organizations be required to invest more than half of their IT budget in training and support systems (Sandholtz, 2001).

IT-Integrated Instruction and the Quality of Learning for Students

Finding 2: A proper combination of IT-based instruction and traditional instruction will positively affect the quality of learning for K–12 students.

On the question of the quality of education, this study found that teachers, students, and principals do not support the application of IT-based instruction in a stand-alone setting; rather, they seek a combination of IT-based instruction and traditional instruction. For example, a majority of students stated that IT-based instruction is important only when supplemented through books, study guides, and traditional lectures in a face-to-face setting between teachers and students. A few teachers opined that when technology-based instruction is offered in a stand-alone setting, students often get more involved with the technology rather than knowledge of the subject. Technology often diverts the minds of the students from valuable knowledge. Thus, IT-based instruction, if not supplemented through traditional means of instruction and face-to-face interactions between teachers and students, is unlikely to offer significant advantages to students.

During the interviews, some principals argued that IT-based instruction in a traditional setting is critical for improving the quality of education. IT-based instruction, however, is unlikely to be successful in enhancing learning unless there is someone who can explain and answer students' questions and course-related concerns. This role cannot be assumed by a computer; only teachers can do it. Therefore, it is critical that IT-based instruction should always be complemented with traditional lectures for enhancing the quality of learning.

These results are similar to the conclusions drawn by Reeves (1998), who argues that technology allows students to organize and analyze real-world data. However, to understand the meaning of information, traditional means of instruction cannot be ignored. Knapp and Glenn (1996) argue that instructional technologies, when used appropriately in a traditional setting, can offer students advantages in understanding the behavior of complex objects through pictures, maps, and graphs, mediated through computer interactions.

IT-Integrated Curriculum and Student Engagement in Learning

Finding 3: A technology-integrated curriculum will positively affect student engagement in learning.

On the question of the effects of technology-integrated curriculum on learning, teachers, students, and principals agreed that a technology-integrated curriculum is more conducive for engaging students in learning. For example, teachers argued that when IT becomes an enabling tool for the acquisition, organization, and analysis of information, IT-based instruction can motivate students to do better. They also stated that as long as technology does not dominate the coursework, IT-based instruction can encourage students to take responsibility for solving problems, making decisions, and coordinating their work with team members and teachers.

In a similar vein, students expressed deep satisfaction with IT-based instruction as long as IT is closely tied in with the core curriculum of the school. The students argued that an expectation of IT integration with course curricula provides them more opportunities for collaborating on group projects and team assignments.

The principals were cautiously optimistic about the effects of technology-integrated curriculum. They argued that when technology is at the "foreground," students often become enamored with style over substance. However, when technology-integrated curriculum is properly managed and IT is kept in the "background," it engages students in self-reflection and appreciation of the knowledge that underlies the technological trappings.

These findings support the view of Penuel, Golan, Means, and Korbak (2000); Sandholtz, Ringstaff, and Dwyer (1997); and Silverstein, Frechtling, and Miyoaka

(2000), who have found that technology-integrated curriculum was successful in maintaining student engagement in coursework. A technology-integrated curriculum positively affected students' problem-solving skills in group projects, team assignments, and other collaborative work (Sandholtz, Ringstaff, and Dwyer, 1997). According to Sandholtz (2001), a technology-integrated curriculum offers students opportunities in exploration, self-reflection, collaborative decision making, and active learning. Similar results were also found by Penuel, Golan, Means, and Korbak (2000) in their research on the Middle School Mathematics through Application Project (MMAP), in which they found that the technology-integrated curriculum positively affected students' experience in learning mathematics (quoted from Ringstaff and Kelley, 2002).

IT-Integrated Instruction and the Competitiveness of Schools

Finding 4: A proper combination of IT-based instruction and traditional instruction will positively affect the competitiveness of K–12 schools.

On the question of the effect on competitiveness of schools from IT investment undertaken for instructional purposes, each group of stakeholders—students, teachers, and principals—has a different view. (For more on the meaning of competitiveness of schools from IT investment, see, for example, Powell and Dent-Micallef, 1997). The teachers argued that a technologically trained and qualified teacher will do a better job in preparing and delivering instructional material to students. In addition, the instructional modules can be reused and modified to meet the various skill levels of students.

Students argued that when IT-based instruction is supplemented with traditional instruction, they get a better understanding and knowledge of the behavior of complex dynamic systems, which are quite difficult to explain via traditional means only. Students also opined that through hands-on experience, they gain a better perspective of the relationships between a concept and the concrete reality.

Principals of K–12 schools stated that IT-based instruction is critical for a school's competitive advantage. They argued that IT instruction, standing alone, is unlikely to offer any significant advantage to students. Therefore, the main aim of K–12 schools should be to integrate IT-based instruction with traditional instruction. The principals also commented that the capability to deliver IT-based instruction puts a progressive face in front of students and their parents, the local community, and the state legislature, all of which can influence budget decisions for the schools. As one of the principals stated, "Just having an IT infrastructure for instructional purposes provides legitimacy to the school. If one begins to make full utilization of the IT infrastructure, IT-based instruction can offer competitive advantages to the school."

These findings support the common assertion that when IT-based instruction is used coherently and backed up by traditional face-to-face interactions between students and teachers, it can create competitive advantages for K–12 schools (Sandholtz, Ringstaff, and Dwyer, 1997). For example, Glennan and Melmed (1996) found that teacher training in the use of technology and a consistent level of student interaction with IT-based instruction in a face-to-face setting with teachers positively affected the competitiveness and success of K–12 schools.

IT-Integrated Instruction and Return on Investment

Finding 5: A proper combination of IT-based instruction and traditional instruction will positively affect the return on IT investment for K–12 schools.

In assessing the financial perspective of IT-based instruction, the findings of this study suggest that structured and organized digital content can help a school lower the costs of its instruction over the long run, since a larger number of students can access the same instructional modules. Moreover, a school can also reduce the costs of instruction as several of the IT-based instructional modules can be reused and easily modified to meet the disparate needs of the students.

In addition, a school can further cut costs because of its need for smaller physical infrastructure, because instead of stacking volumes of books, articles, and supplemental reading materials (hard copies), it can subscribe to a digital library that can be accessed anytime, anywhere, by teachers, students, and other key patrons. An integrated IT infrastructure helps not only in reducing the numbers of administrators and staff members, but also in increasing the efficiency of most routine tasks, which can easily be downloaded from the networks and completed over the Internet. Moreover, as a school gains experience in understanding the nuances of technology-based instruction, it can acquire funds from external sources and grant agencies.

Measuring revenues gained from the use of technology-based instruction requires a longitudinal study, because in the initial stage of initiation and implementation of IT, a school will expend considerable resources in time and money. Only when IT expenses subside below a threshold level will the school begin to gain positive returns from its IT investment. Despite this limitation in measurement, this author subscribes to the notion that schools, in the long run, are likely to enhance their productivity by using IT for instructional purposes. So the sooner a school gets a better handle on the application of technology-based instruction, the better its financial condition is likely to be as compared to schools that enter the market for IT-based instruction late. This conjecture is made on the basis of research studies showing that firms that have gained experience in the implementation of technology are likely to be more successful in exploiting the benefits from the use of technology (Neo, 1988).

IT-Integrated Instruction and Student Knowledge

Finding 6: IT-based instruction, when properly combined with traditional instruction, will positively affect students' learning and knowledge. Students are the core customers of a school and the basic mission of a school is to educate students. If students can get more value from IT-based as compared to traditional instruction, it can easily be inferred that IT-based instruction is more productive. The findings of this study show that IT-based instruction is not necessarily advantageous for students if delivered in a stand-alone setting. Only a combination of IT-based instruction and traditional instruction is beneficial for enhancing students' knowledge of subject areas.

This finding is consistent with the results of several research studies that found that when IT-based instruction is carried out in parallel with traditional methods, the students perform better in standardized tests as compared to students from schools where IT-based instruction is not emphasized. For example, in a longitudinal study spanning almost a decade, researchers found that elementary students—from kindergarten to grade 5—who were taught according to IT-based instructional methodology in a classroom setting outperformed those students who were taught through traditional means only (Butzin, 2000). That study further found that those taught through technology-based instruction in the classroom were more prone to choose science and mathematics in middle school than their counterparts taught through traditional means only. Kulik (1994), through a meta-analysis of over 500 research studies, concluded that students who were taught through IT as well as traditional means gained an average of 9 to 22 percent on standardized tests over control groups. An average student that had IT-based instruction complemented with traditional instruction scored at the 64th percentile, compared to students taught through traditional means only, who scored at the 50th percentile.

In addition, IT-based instruction is more visible and transparent to all sorts of stakeholders—students and their parents, teachers, principals, community leaders, state legislators, and other external agencies—allowing them to get involved and contribute their input to enhance the quality of instruction for students.

When traditional instruction is complemented with IT, students gain a better perspective of the issues involved in the analysis of complex and dynamic objects. For example, through Interactive Physics, students can explore in depth the topics in Newtonian mechanics—momentum, force, and acceleration (Jonassen, 1993). Similarly, as students gain interest in specific areas, IT-based instruction, complemented with traditional lectures, can provide students access to various sources for locating subject matter and enhance their ability to interpret the knowledge in new contexts. The use of simulations, computer games, diagrams, and maps provides students a visual understanding of the behaviors of complex objects. However, to understand the meaning in a "practical" context, students still need instruction from a "live" instructor, who can provide a clear perspective of the subject matter.

IT-Integrated Instruction and the Quality of Instruction

Finding 7: A proper combination of IT-based instruction and traditional instruction, accompanied by the restructuring of existing work practices, will have a positive effect on the quality of instruction for students. The findings of this study show that simply replacing traditional instruction with IT-based instruction should not be the main goal of K–12 schools. Rather, to gain returns from IT-based instruction, the schools should be willing to restructure programs and course content so they become amenable to IT and a proper combination of IT-based instruction backed up with traditional instruction can be prepared and delivered to students.

The results of this study show that IT-based instruction can be used for creating a student-centered learning environment. The schools, however, must reorganize their programs to meet the needs, knowledge, and skills of disparate groups of students. This need for understanding internal work process is similar to the conclusion of Tiene and Luft (2002). After interviewing teachers, they found that IT-based instruction in face-to-face settings presented some significant advantages. Teachers stated that both they and their students improved their skills in subject matter while working with technology. Moreover, they stated that because of technology, the assignments could be individualized, allowing students to work more independently as well as cooperatively with other students. The teachers also contended that technology allowed them to dynamically present material to the class, enhancing student learning.

A similar argument, emphasizing the restructuring of internal processes for maximizing the gains from IT-based instruction, is provided by Glennan and Melmed (1996). They affirm that the introduction of technology in the classroom over time requires restructuring of instructional content and delivery. Moreover, technology also forces a change in the attitudes of teachers and students toward more fully utilizing the advantages of IT-based instruction. For example, by recognizing the potential of IT in instruction and learning, teachers begin to understand that in the present environment, learning is more than a one-way dialogue—from teacher to student. Rather, it becomes a collaborative exercise between teachers and students with continued guidance from the teacher to the student. Moreover, students, over time, are expected to initiate learning and discover knowledge. The role of teachers becomes that of a facilitator, helping and guiding students through problem-solving and skill-building exercises.

IT-Integrated Instruction and the Growth of Schools

Finding 8: A proper combination of IT-based instruction and traditional instruction for students will have a positive effect on the growth of K–12 schools.

Growth is conceptualized in terms of the demand for a K–12 school's instructional products and services by other schools and tutorial organizations. In addition, growth refers to improvements in the efficiency, effectiveness, and quality of instructional services that a K–12 school provides to its students.

Learning and growth are usually evaluated based on the long-term performance objectives of a firm. In the case of an education system, the common recommendation is that schools should prepare students for learning and growth. Only when a K–12 school can prepare its students to meet their future career obligations successfully can it realize continued demands for its digital products and services in the marketplace from other teaching institutions and tutorial organizations. In order to enhance the demands for its instructional material, the school should make provisions for teaching release time so that teachers can engage in the design of innovative digital instructional material for enhancing the quality of instruction for students. One important issue for schools becomes that they continually refine their IT-based instructional material to prepare students for their future career obligations.

It is a common belief that continued use of IT makes students comfortable in undertaking knowledge work. *Knowledge work* refers to the process of generation, accessing, manipulation, and transformation of information and knowledge. Since, presently, a majority of jobs have shifted from manufacturing to the high-technology and service sectors, the requirements for employers have become to hire those people who can work with IT and effectively use information and knowledge in a company's products and services to meet customers' unique requirements.

Therefore, a school that effectively uses IT-based instruction and backs it with traditional lessons and explanations can prepare students for handling future work that involves a high degree of technological skills. This very fact, if considered reliable and unchanging, is sufficient for the growth of technologically progressive schools. The findings of this study also suggest that as a school gains competency in creating, combining, and delivering IT-based instructional material along with traditional instruction, its profitability and returns in the marketplace begin to increase because of the "first mover" advantage (Barney, 1991).

Recommendations

Based on the findings of this study, the following recommendations are offered:

Align IT with School's Strategic Vision

Recommendation 1: IT for instructional purposes should be based on the strategic vision of the school so that it contributes to the educational objectives of the school.

Technology should be linked directly to the long-term objectives and strategies of the school. In the absence of a clear relationship between technology and the school's objectives, the benefits of technology are unlikely to show any distinct advantage in students' skills and performance. A rich educational environment not only requires a match between instructional goals, student performance, and faculty satisfaction, but also looks for innovative use of technology in creating and delivering instructional material to enhance students' creativity, imagination, and problem-solving skills. In other words, the technology strategy of a school should not only meet the current educational needs of the students, but also be able to deal with the potential and need-based demands of students in the future.

Before a school plans to use technology for instructional purposes, stakeholders—administrators, teachers, instructional staff, technology coordinators, students, parents, and representatives of the community—should come together to set a strategic plan. The essence of this plan should be to understand the specific needs of the students, community, and the nation as a whole. The committee should also develop clear educational standards and goals, and a clear vision of how the technology can be best integrated to realize the mission of the school. Such a committee should also determine the effectiveness of the chosen strategies by evaluating progress and outcomes regularly.

The committee makes a determination of the types of technology that will best support efforts to meet the school's educational goals. This is important because different kinds of technologies lead to different kinds of educational outcomes. For example, Bruce and Levin (1997) classify the use of technology in education in four categories:

- For the purpose of inquiry—such as data modeling, spreadsheets, access to online databases, and hypertext
- For communication purposes—e-mail, synchronous, and asynchronous conferencing
- For construction purposes—computer-aided design, robotics, and control systems
- For the purpose of expression—interactive video, animation software, and music composition

The classification makes clear that different kinds of technologies have different capabilities and constraints, so these technologies require different ways of integration with traditional modes of instruction. One common mistake many schools make is that they do not account for the ongoing costs of maintaining, supporting, and replacing computer equipment. Simply acquiring technology in the initial phase does not offer benefits; benefits are realized gradually over the long run. Therefore, a strategic planning exercise should be done to assess the long-term benefits and costs of technology. Moreover, such plans require continual revision as changes in the institutional and external environments occur.

In taking responsibility for sketching out a vision and learning goals for the students, the committee should ensure that the technology can meet the specific needs of those with special needs. For example, students who are likely to benefit most from technology-based education are special-needs students, minority students, disadvantaged students, students at risk of educational failure, and rural and inner-city students (Gaines, Johnson, and King, 1996). To increase educational opportunities for these students, the committee should look for ways that these students can access technological resources from their homes and thus engage in meaningful coursework that would be helpful for them in their work.

Due to the paucity of resources, schools are required to prioritize the needs of technology for instructional purposes. That means stakeholders should make the rational decision to make use of computers where it is truly advantageous and will help in getting content across effectively and efficiently. Second, technology should be integrated with instruction and should complement traditionally prepared lessons. In other words, the technology itself should not take primacy over the instructional goals. Therefore, school officials should work with a plan that gradually increases the scope of scalable technology in classroom instruction so that it becomes an integral component of traditional instruction.

Technology is not the magic bullet for increasing standards of the school, unless it is put in use with a specific purpose. A planning committee should take an active role in linking technology use with the long-term vision, learning goals, and competitive strategy of the school. In other words, the technology strategy should clearly support the educational strategy of the school.

Integrating technology into instruction requires resources and investment. Moreover, the effect of such integration is not so obvious in the short run; therefore, only when schools can afford a sufficient level of investment in continued updates and maintenance of technology over the long run are the actual benefits of technology-based instruction realized.

Similarly, technologically knowledgeable teachers who believe that technology use will lead to significant benefits for their students must undertake the role of technology integrators. In a paper discussing the cost, utility, and value of technology, Wahl (2000) suggests that until schools are committed to long-term support of teacher training, the benefits of technology in education will not be realized. He argues that successful schools spend only 30 percent of their budget on technological equipment and 70 percent on the "human infrastructure" to support ongoing training and technical assistance. Therefore, the benefits of technology-based instruction can be realized only when human training and motivation takes priority over the computer equipment.

Balance IT-Based and Traditional Instruction

Recommendation 2: K–12 schools should create a balance between IT-based instruction and traditional instruction for enhancing students' knowledge and experience in learning.

If online instructional material is not complemented with traditional instruction in a physical classroom setting, students are unlikely to gain conceptual knowledge of complex phenomena, even though they could provide correct answers to the existing questions. Not all of the knowledge can be communicated through IT-based instructional media; therefore, exclusive use of online instruction does not provide the means to capture "tacit knowledge." Activities such as how to perform a complex surgical operation or craft an original piece of a lab experiment often require face-to-face interactions and serious involvement between teachers and stu-

Recommendations

1. IT for instructional purposes should be based on the strategic vision of the school so that it contributes to the educational objectives of the school.
2. K–12 schools should create a balance between IT-based instruction and traditional instruction for enhancing students' knowledge and experience in learning.
3. IT-based instruction should be clearly tied to the course curricula.
4. Teachers should be knowledgeable about the use of instructional technology so they can create and deliver instructional material effectively to students.
5. Teachers should restructure their traditional role in schools to realize the full benefits of the integration of technology-based instruction and traditional instruction.
6. Schools should commit a substantial investment in technology maintenance to ensure the continued use of technology in instruction.

dents. In addition, without adequate monitoring, online instruction may encourage students to plagiarize and skim course material, rather than attempt to develop an in-depth understanding of the subject area. Therefore, to avoid such practices, online technological instruction should be supplemented with traditional instruction.

There is no doubt that technology offers several avenues for enhancing the effectiveness of traditional education. For example, through IT, students and teachers can gain access to digital archives and establish contact after school hours, and teachers can establish contact with community members. With the growing use of multimedia, the emphasis has been how best to make use of these technologies for supporting the educational objectives of students in a cost-effective manner (Means and Olson, 1995). However, mere acquisition of information does not necessarily lead to critical and conceptual thinking among students. If the objective is to enhance students' higher-order thinking, schools need to appropriately integrate technology-based instruction with traditional instruction. If the primary objective is toward rote learning, tutoring systems and computer-assisted instruction can be used as stand-alones, without fully integrating with the traditional mode of instruction. In other words, as the skill level of the students begins to increase, technology-based instruction needs to be backed up with traditional instruction.

In sum, technology-based instruction by itself could be used to help students learn faster, but when the aim is to promote critical thinking, technology must be coordinated with traditional instruction. Such integration offers the advantage of efficiency and creativity and has the potential to raise students' achievement and increase their engagement and motivation to learn. Simply because a school has purchased instructional technology and teachers are challenged to use it does not automatically lead to a higher level of performance for students. It is rather the awareness and understanding of how to integrate technology in coursework that ensures students will benefit from technology-based instruction. The challenge for schools is not simply acquiring the technology, but how best to make use of technology so that it provides competitive advantages to the schools and raises the academic standards of the students.

The integration of IT-based instruction and traditional instruction should not be an end itself; rather, the aim should be to foster students' ability to undertake critical responsibilities in analyzing and solving complex problems. When students are taught with a combination of digital and traditionally prepared instruction, they are likely to get a mastery of social knowledge and an appreciation of the technology. At the same time, by preparing a meaningful combination of digital and traditional instructional content, teachers are likely to appreciate the value of IT-based instruction. If teachers are conversant with the use of IT-based instruction in the classroom, they can easily update, refine, and customize digital contents to enhance the quality of instruction for their students.

Tie IT to Curricula

Recommendation 3: IT-based instruction should be clearly tied to the course curricula.

Technology cannot be divorced from the school curricula. To increase the quality of instruction for students, technology should be clearly tied to the course curricula, incorporating meaningful digital content to enhance the effectiveness of online and traditionally delivered instruction. Often, how digital lessons are planned, blended with traditional instruction, and delivered will depend on the state of the technology in the school. However, if schools are looking for ways to integrate technology-based learning with traditional modes of teaching, teachers, principals, and policy makers will be required to initiate changes in existing work practices to make the best possible use of technology that will positively affect students' performance and conceptual skills. Sandholtz, Ringstaff, and Dwyer (1997) state that courseware that includes the use of software designed for educational programs should reflect curricular standards and take into account how students can develop conceptual learning (Silverstein, Frechtling, and Miyoaka, 2000).

Schools cannot afford to ignore the impact of technology on enhancing the quality of education for students. At the same time, however, technology in itself is not the solution; rather, it is the integration of technology and school curricula that is important in improving the performance and satisfaction of students.

An understanding of the linkages between IT and the core curriculum creates opportunities for schools to innovate and offer quality education to students. This view is explained by Sandholtz, Ringstaff, and Dwyer (1997), and Silverstein, Frechtling, and Miyoaka (2000) in stating that students feel more engaged with their studies when IT does not play a dominant role. Instead, IT is considered one of the many tools that can be applied using various teaching methods. However, for sustaining innovation, schools need to continually examine their IT-based offerings in parallel with traditional instruction and plan how best they can deliver a combination of IT-based and traditional instructional material to students. As Bozeman and Baumbach (1995) state, when technology becomes a part of the core curriculum, schools become smarter in using technology through "learning by doing." Similarly, Means and Olson (1995) argue that in order to increase the quality of education for students, digital instructional modules need to be supplemented with timely teacher-to-student feedback.

Train Teachers in IT

Recommendation 4: Teachers should be knowledgeable about the use of instructional technology so they can create and deliver instructional material effectively to students.

To motivate faculty members about the use of new technologies for instructional purposes, the relevance of organizational incentives and training becomes obvious. To encourage faculty members to adopt, evaluate, and use these technologies, their performance should be tied to the ease with which they are able to integrate technology into their traditional mode of teaching. In the initial stages of such changes, schools should provide a sufficient level of incentives to teachers through training programs, merit increases, and course reduction. Wenglinsky (1998) argues that one of the primary reasons that teachers do not use technology in their classrooms is their lack of experience with it. Wenglinsky also finds that teachers who received training in the use of technology were more likely to use computers in effective ways than those who had not participated in such training.

Training becomes critical for two reasons: First, teachers become proficient in the use of technology; and second, they begin to understand the importance of technology-integrated lessons. Teachers who become conversant with the technology also begin to understand how to combine technology-based instruction with traditional instruction in ways that offer the maximum utilization of technology for the education of students.

Technology does not remain static; developments and innovations in technology are rapid. Therefore, to sustain teachers' motivations, schools must ensure that teachers receive periodic training in the use of new technologies for instructional purposes. When teachers become confident enough, they begin to take initiative in integrating technology with the course curriculum to offer maximum advantages to the students. Training programs are important to create interplay between technology-based and traditional instruction, so that students get maximum value from the technology. The use of training also brings together teachers from other communities to discuss how best to make use of technology for students.

To enhance students' knowledge and learning, teachers should be able to offer them a proper combination of technology-based and traditional instruction. To achieve this objective, teachers need to set a schedule each week about how they will integrate technology-based and traditional instruction the following week. Such a schedule is important, because it keeps students alert about technology use and allows students to explore new course material in which they are interested.

Restructure Role of Teachers

Recommendation 5: Teachers should restructure their traditional role in schools to realize the full benefits of the integration of technology-based instruction and traditional instruction.

Seeing that technology affects almost every walk of life, teachers cannot ignore the potential of IT in education systems. To perform their duties in a technologically intensive learning environment, teachers need to play several roles. Not only are they required to act as knowledge presenter, but also to play the role of knowledge facilitator. Often they will perform both roles simultaneously: knowledge presenter as well as knowledge facilitator. As a knowledge presenter, teachers deliver instruction in a traditional physical classroom setting; as a knowledge facilitator, they create a computer-supported learning environment and provide continued feedback to students to enhance their thinking and imagination.

At the K–12 level, students demand direction as well as support. So to meet the expectations of students, technology-based instruction should complement traditional instruction. This kind of strategic outlook does not obliterate the need for teachers; rather, their roles become different. They act like coaches rather than monitors, and become facilitators rather than experts.

Invest in Technology Maintenance

Recommendation 6: Schools should commit a substantial investment in technology maintenance to ensure the continued use of technology in instruction.

The long-term planning of a school for technology-based education is considered quite critical. The main reason is that technology requires more than half of technology expenses in regular maintenance and updating of the systems. Second, as the role of technology begins to take priority, maintenance becomes even more critical.

To sustain the growth of technology-based education, a school needs to make substantial investment in a flexible technical infrastructure. IT infrastructure should not only support the current educational goals of the schools, but be able to sustain future growth without causing major disruptions in instruction. The infrastructure should be easy to modify and maintain support for the future educational needs of the schools.

For increasing the scope of IT-based instruction, the schools must commit about 60 to 70 percent of their IT budget for technology maintenance, replacement of legacy systems, and support staff. All of these activities not only require a huge amount of investment but also demand the attention of school administrators to continually evaluate the effectiveness of technology in instruction.

Conclusion

Measuring the impact of IT-based instruction for K–12 schools and their stakeholders—students, teachers, and principals—is difficult. There are different views and findings on the effects of IT-based instruction for K–12 schools. Research studies find conflicting results on the effects of IT-based instruction on students. Moreover, there is not a substantial body of research that illustrates the effect of IT investment on the bottom line for schools. This report makes an attempt to fill the gap by providing a close look at the effect of IT-based instruction for K–12 schools in Maryland.

The findings of this study show that IT-based instruction can provide returns to schools if the instruction is managed to meet the needs and interests of the students. The results support the common view that merely having IT in the schools does not offer advantages to the local school stakeholders. To capitalize on the potential of IT, teachers should have sufficient knowledge to create and deliver instructional materials to students. However, the results also reveal that schools are facing challenges in providing training to faculty members because of budget problems. The findings indicate that the use of IT-based instruction in combination with traditional instruction enhances student learning. Further, the results find that integration of technology for instructional purposes requires a serious understanding of the capabilities, constraints, and challenges of IT in the preparation and delivery of instruction to students.

The results support the view that in today's competitive environment, the use of technology is becoming increasingly critical for K–12 schools. Schools that can demonstrate the innovative use of technology are able to attract motivated and technologically learned faculty as well as quality students. However, the innovative use of technology cannot be carried out with technology alone. It needs to be substantiated with knowledgeable faculty that can create a balance between traditional and technology-based instruction.

Schools cannot ignore the importance of IT-based education—the results support this contention. However, at the same time, technology-based education should be used to complement, not replace, traditional educational instruction. Moreover, a school cannot simply purchase and acquire new technology in the hope that it will create worthwhile improvement in students' achievement. To create meaningful roles for instructional technology, schools must have a strategic plan that clearly demonstrates how technology would lead to the achievement of the educational vision and objectives. In other words, before policy makers and stakeholders agree on a technology plan, they must have a sound understanding of the long-term strategies and the direction in which the school wants to go. Careful planning for technology use is critically important because technology requires a large investment, which is not reflected in the initial purchase but can add up in maintenance and regular support.

The results of this study show that before a school invests in acquiring and purchasing technology, school administrators should be clear about the educational vision and learning goals for the students. Only after setting a strategic vision and goals should the school determine what kind of technological tools can best serve the vision and goals of the school, as well as how these tools can best help students learn and how technology can be used to promote learning goals.

In sum, to reap the benefits of technology-based instruction, technology should not be an add-on piece of the course curriculum. Rather, it should be integrated with all aspects of teaching and learning, including traditional instruction, to provide the best mix of instructional content for students. In addition, to make maximum use of technology for educational purposes, teachers should receive ongoing training in developing meaningful instructional strategies. Finally, to sustain the growth of integrated technology-based instruction, schools must decide how they are going to make investment decisions for developing a flexible IT infrastructure and support system, since technology requires continued maintenance and support. Moreover, as technology changes rapidly, significant investment is needed in replacing legacy systems with new ones.

Appendix: Electronic Classroom Types, Assumptions, and Related Models

Electronic Classroom Type	Principal Pedagogical Assumptions
The Vision to Automate Instructor Console	Instructor is at the center of the classroom activity. Presentation technologies can make the delivery of information more memorable and interesting.
Instructor Console and Stand-Alone Student Computers	Students learn better if they can emulate what the instructor is doing on the computer. Learning is more effective when it is interactive.
Computer-Assisted Learning	Students benefit when they control the pace of learning. Feedback should be frequent.
Distance Learning	Weakness in education is the lack of availability of good courses and faculty. Accessibility in remote locations or smaller schools can be efficiently provided via telecommunications.
The Vision to Informate Up Key Response Pads	The instructor needs feedback. The ability to elicit responses via technology is superior to hand-raising.
Instructor-Student E-mail	Feedback, even delayed, is better than no feedback. Limited access to instructors limits communications.
The Vision to Informate Down Learning Networks	Delivery of information is not a pressing problem, but rather the lack of current information from realistic contexts. Students create knowledge through information exploration.
Hypermedia/Internet	Students need to create their own knowledge structures.
Simulation/Virtual Reality	The more real the context, the more effective the learning. Students should be provided the means to experience the phenomenon during class.
Synchronous Communication Classrooms	Participation is critical to the learning process. Anonymity encourages participation.
Groupware-Support Synchronous Communication Classrooms	Structure imposed on communication is effective in helping students learn. Communication is more efficient when structured.
The Vision to Transform Virtual Continuous Learning Asynchronous Communication Across Distances	Learning is an ongoing process. Time should be flexible. Learning need not be geographically dependent.
Groupware-Support Asynchronous Communication Across Distances	Ad hoc communication is more effective when supported with a structure.

Adapted from Leidner and Jarvenpaa (1995).

Bibliography

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management* 17: 99–120.

Bednar, A., D. Cunningham, T. Duffy, and J. Perry. (1992). Theory into Practice: How Do We Link? In T.M. Duffy and D. Jonassen D. (eds.), *Constructivism and the Technology of Instruction: A conversation,* 17–34. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bozeman, W., and D. Baumbach, D. (1995). *Educational Technology: Best Practices from America's Schools*. Princeton, NJ: Eye on Education, Inc.

Bruce, B. C., and J. A. Levin. (1997). Educational technology: Media for inquiry, communication, construction, and expression. *Journal of Educational Computing Research* 17 (1): 79–102.

Butzin, S. M. (2000). Project Child: A Decade of Success for Young Children [Feature]. *Technology Horizons in Education Journal,* June, 27(11). Retrieved from http://www.thejournal.com/magazine/vault/A2882.cfm

Coley, R., J. Cradler, and P. Engel. (1997). Computers and Classrooms: The Status of Technology in U.S. Schools (Educational Testing Service Policy Information Report). Retrieved from ftp://ftp.ets.org/pub/res/compclss.pdf

Culp, K., J. Hawkins, and M. Honey (1999). Review Paper on Educational Technology Research and Development. NewYork: Education Development Center, Center for Children and Technology.

Davey, K. (1999). The Information Revolution Has Improved Off-Campus Education. In L. K. Egendorf (ed.), *The Information Revolution: Opposing Viewpoints*. Farmington Hills, MI: Greenhaven Press, 83–88.

Ehrmann, S. (1989). Improving a Distributed Learning Environment with Computers and Telecommunications. In R. Mason and A. Kaye (eds.), *Mindweave: Communication, Computers, and Distance Education*. Oxford: Pergamon Press, 255–259.

Gaines, C. L., W. Johnson, and D. T. King (1996). Achieving Technological Equity and Equal Access to the Learning Tools of the 21st Century. *Technological Horizons in Education Journal,* June 23 (11): 74–77.

Glennan, T. K., and A. Melmed. (1996). Fostering the Use of Educational Technology: Elements of a National Strategy. Santa Monica, CA: RAND. Retrieved from http://www.rand.org/publications/MR/MR682/contents.html

Heinich, R., M. Molenda, and J. Russell (1993). *Instructional Media and the New Technologies of Instruction*. New York: Macmillan Publishing Company.

Jonassen, D. H. (1993). Thinking Technology. *Educational Technology,* January, 35–37.

Kerr, C. (1994). *Higher Education Cannot Escape History: Issues for the Twenty-First Century*. Albany: State University of New York.

Knapp, L. R., and A. D. Glenn. (1996). *Restructuring Schools with Technology*. Boston: Allyn and Bacon.

Kulik, J. A. (1994). Meta-Analytic Studies of Findings on Computerized Instruction. In E. Baker and H. O'Neil (eds.), *Technology Assessment in Education and Training.* Hillsdale, NJ: Lawrence Erlbaum Associates.

LeFevre, A, T. (1999). Technology Alone Has Not Improved Education. In L. K. Egendorf (ed.), *The Information Revolution: Opposing Viewpoints.* Farmington Hills, MI: Greenhaven Press, 78–82.

Leidner, D. E., and S. L. Jarvenpaa (1995). The Use of Information Technology to Enhance Management School Education: A Theoretical View. *MIS Quarterly,* September, 19, 265–291.

Maryland State Department of Education (2002). Maryland Classroom Achievement Matters Most: Maryland's New Plan for Public Schools: 8 (1), 1–8.

Means, B., and K. Olson (1995). *Restructuring Schools with Technology: Challenges and Strategies.* Menlo Park, CA: SRI International.

Neo, B. S. (1988). Factors Facilitating the Use of Information Technology for Competitive Advantage: An Exploratory Study. *Information and Management* (15): 191–201.

O'Loughlin, M. (1992). Rethinking ScienceEducation: Beyond Piagetian Constructivisim Toward a Sociocultural Model of Teaching and Learning. *Journal of Research in Science Teaching* 28 (2): 791–820.

Penuel, B., S. Golan, B. Means, and C. Korbak. (2000). Silicon Valley Challenge 2000: Year 4 Report. Menlo Park, CA: SRI International.

Piaget, J. (1990). *The Child's Conception of The World.* New York: Littlefield Adams.

Powell, T. C., and A. Dent-Micallef. (1997). Information Technology as Competitive Advantage: The Role of Human, Business and Technology Resources. *Strategic Management Journal* (18): 375–405.

Reeves, T. C. (1998). The impact of media and technology in schools: A research report prepared for The Bertelsmann Foundation. Retrieved from http://www.athensacademy.org/instruct/media_tech/reeves0.html

Ringstaff, C., and L. Kelley. (2002). The learning return on our educational technology investment. Retrieved from http://www.wested.org/online_pubs/learning_return.pdf

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.

Sandholtz, J. H., C. Ringstaff, and D. C. Dwyer. (1997). *Teaching with Technology: Creating Student-Centered Classrooms.* New York: Teachers College Press.

Silverstein, G., J. Frechtling, and A. Miyoaka. (2000). Evaluation of the Use of Technology in Illinois Public Schools: Final Report (prepared for Research Division, Illinois State Board of Education). Rockville, MD: Westat.

Sivin-Kachala, J., and E. Bialo. (2000). 2000 Research Report on The Effectiveness of Technology in Schools (7th ed.). Washington, DC: Software and Information Industry Association.

Skinner, B. F. (1976). *About Behaviorism.* New York: Vintage.

Statham, D. S., and C. R. Torell. (1999). Technology in Public Education in The United States. Retrieved from http://www.tea.state.tx.us/Textbooks/archives/litrevie.htm

Sveiby, K. (1997). *The New Organizational Wealth: Managing & Measuring Knowledge-Based Assets.* San Francisco: Berrett-Koehler Publishers.

Tiene, D., and P. Luft. (2002). The Technology-Rich Classroom, August, ASBJ. Retrieved from http://www.asbj.com/2002/08/0802technologyfocus.html

Valdez, G., M. McNabb, M. Foertsch, M. Anderson, M. Hawkes, and L. Raack. (2000). *Computer-Based Technology and Learning: Evolving Uses and Expectations.* Naperville, IL: North Central Regional Educational Laboratory.

Vygotsky, L.S. (1962). *Thought and Language.* Cambridge, MA: MIT Press.

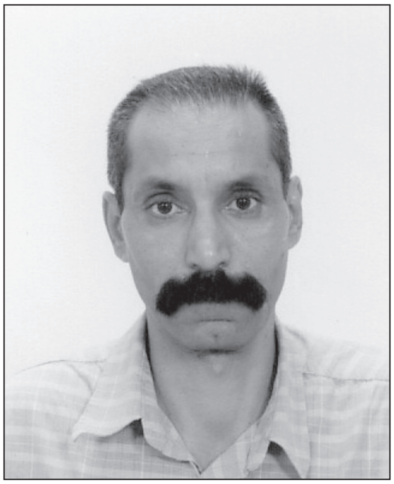
Wahl, E. (2000). *Cost, Utility, and Value.* New York: Education Development Center, Center for Children and Technology.

Wenglinsky, H. (1998). *Does It Compute? The Relationship between Educational Technology and Student Achievement in Mathematics.* Princeton, NJ: Educational Testing Service.

Willis, J., A. D. Thompson, and W. A. Sadera (1999). Research on Technology and Teacher Education: Current Status and Future Directions. *Journal of Educational Technology Research and Development* 47 (4): 29–45.

Zuboff, S. (1988). *In the Age of the Smart Machine: The Future of Work and Power.* New York: Basic Books.

ABOUT THE AUTHOR



Ganesh D. Bhatt is an Associate Professor in the Department of Information Science and Systems at Morgan State University, Baltimore. Currently, he is actively exploring the field of knowledge dynamics, information management, and e-commerce models. Dr. Bhatt has published articles in *Decision Support Systems, OMEGA, Journal of Knowledge Management, Journal of Knowledge & Process Management,* and *International Journal of Production & Operation Management,* among others.

He obtained his D.B.A. from Southern Illinois University, Carbondale. His M. Tech. and B. Tech. degrees are from I.I.T. Delhi (India) and I.T. B.H.U. Varansi (India), respectively.

KEY CONTACT INFORMATION

To contact the author:

Ganesh D. Bhatt
Associate Professor
Department of Information Science and Systems
Morgan State University
Baltimore, MD 21251
(443) 885-3640

e-mail: gbhatt@jewel.morgan.edu

CENTER REPORTS AVAILABLE

COLLABORATION: PARTNERSHIPS AND NETWORKS

Leveraging Networks to Meet National Goals: FEMA and the Safe Construction Networks
(March 2002)
William L. Waugh, Jr.

21st-Century Government and the Challenge of Homeland Defense
(June 2002)
Elaine C. Kamarck

Assessing Partnerships: New Forms of Collaboration (March 2003)
Robert Klitgaard and Gregory F. Treverton

Leveraging Networks: A Guide for Public Managers Working across Organizations (March 2003)
Robert Agranoff

Extraordinary Results on National Goals: Networks and Partnerships in the Bureau of Primary Health Care's 100%/0 Campaign (March 2003)
John Scanlon

Public-Private Strategic Partnerships: The U.S. Postal Service-Federal Express Alliance
(May 2003)
Oded Shenkar

The Challenge of Coordinating "Big Science" (July 2003)
W. Henry Lambright

Communities of Practice: A New Tool for Government Managers
(November 2003)
William M. Snyder and Xavier de Souza Briggs

Collaboration and Performance Management in Network Settings: Lessons from Three Watershed Governance Efforts (April 2004)
Mark T. Imperial

The Quest to Become "One": An Approach to Internal Collaboration (February 2005)
Russ Linden

Cooperation Between Social Security and Tax Agencies in Europe
(April 2005)
Bernhard Zaglmayer, Paul Schoukens, and Danny Pieters

E-GOVERNMENT

Supercharging the Employment Agency: An Investigation of the Use of Information and Communication Technology to Improve the Service of State Employment Agencies
(December 2000)
Anthony M. Townsend

Assessing a State's Readiness for Global Electronic Commerce: Lessons from the Ohio Experience
(January 2001)
J. Pari Sabety and Steven I. Gordon

Privacy Strategies for Electronic Government (January 2001)
Janine S. Hiller and France Bélanger

Commerce Comes to Government on the Desktop: E-Commerce Applications in the Public Sector
(February 2001)
Genie N. L. Stowers

The Use of the Internet in Government Service Delivery
(February 2001)
Steven Cohen and William Eimicke

State Web Portals: Delivering and Financing E-Service (January 2002)
Diana Burley Gant, Jon P. Gant, and Craig L. Johnson

Internet Voting: Bringing Elections to the Desktop (February 2002)
Robert S. Done

Leveraging Technology in the Service of Diplomacy: Innovation in the Department of State
(March 2002)
Barry Fulton

Federal Intranet Work Sites: An Interim Assessment (June 2002)
Julianne G. Mahler and Priscilla M. Regan

The State of Federal Websites: The Pursuit of Excellence (August 2002)
Genie N. L. Stowers

State Government E-Procurement in the Information Age: Issues, Practices, and Trends (September 2002)
M. Jae Moon

Preparing for Wireless and Mobile Technologies in Government
(October 2002)
Ai-Mei Chang and P. K. Kannan

Public-Sector Information Security: A Call to Action for Public-Sector CIOs (October 2002, 2nd ed.)
Don Heiman

The Auction Model: How the Public Sector Can Leverage the Power of E-Commerce Through Dynamic Pricing (November 2002, 2nd ed.)
David C. Wyld

The Promise of E-Learning in Africa: The Potential for Public-Private Partnerships (January 2003)
Norman LaRocque and Michael Latham

Digitally Integrating the Government Supply Chain: E-Procurement, E-Finance, and E-Logistics (February 2003)
Jacques S. Gansler, William Lucyshyn, and Kimberly M. Ross

Using Technology to Increase Citizen Participation in Government: The Use of Models and Simulation (April 2003)
John O'Looney

Seaport: Charting a New Course for Professional Services Acquisition for America's Navy (June 2003)
David C. Wyld

E-Reporting: Strengthening Democratic Accountability
(February 2004)
Mordecai Lee

Understanding Electronic Signatures: The Key to E-Government (March 2004)
Stephen H. Holden

Measuring the Performance of E-Government (March 2004)
Genie N. L. Stowers

Restoring Trust in Government: The Potential of Digital Citizen Participation (August 2004)
Marc Holzer, James Melitski, Seung-Yong Rho, and Richard Schwester

From E-Government to M-Government? Emerging Practices in the Use of Mobile Technology by State Governments (November 2004)
M. Jae Moon

Government Garage Sales: Online Auctions as Tools for Asset Management (November 2004)
David C. Wyld

Innovation in E-Procurement: The Italian Experience (November 2004)
Mita Marra

FINANCIAL MANAGEMENT

Credit Scoring and Loan Scoring: Tools for Improved Management of Federal Credit Programs (July 1999)
Thomas H. Stanton

Using Activity-Based Costing to Manage More Effectively (January 2000)
Michael H. Granof, David E. Platt, and Igor Vaysman

Audited Financial Statements: Getting and Sustaining "Clean" Opinions (July 2001)
Douglas A. Brook

An Introduction to Financial Risk Management in Government (August 2001)
Richard J. Buttimer, Jr.

Understanding Federal Asset Management: An Agenda for Reform (July 2003)
Thomas H. Stanton

Efficiency Counts: Developing the Capacity to Manage Costs at Air Force Materiel Command (August 2003)
Michael Barzelay and Fred Thompson

Federal Credit Programs: Managing Risk in the Information Age (April 2005)
Thomas H. Stanton

HUMAN CAPITAL MANAGEMENT

Profiles in Excellence: Conversations with the Best of America's Career Executive Service (November 1999)
Mark W. Huddleston

Reflections on Mobility: Case Studies of Six Federal Executives (May 2000)
Michael D. Serlin

Managing Telecommuting in the Federal Government: An Interim Report (June 2000)
Gina Vega and Louis Brennan

Using Virtual Teams to Manage Complex Projects: A Case Study of the Radioactive Waste Management Project (August 2000)
Samuel M. DeMarie

A Learning-Based Approach to Leading Change (December 2000)
Barry Sugarman

Labor-Management Partnerships: A New Approach to Collaborative Management (July 2001)
Barry Rubin and Richard Rubin

Winning the Best and Brightest: Increasing the Attraction of Public Service (July 2001)
Carol Chetkovich

A Weapon in the War for Talent: Using Special Authorities to Recruit Crucial Personnel (December 2001)
Hal G. Rainey

A Changing Workforce: Understanding Diversity Programs in the Federal Government (December 2001)
Katherine C. Naff and J. Edward Kellough

Life after Civil Service Reform: The Texas, Georgia, and Florida Experiences (October 2002)
Jonathan Walters

The Defense Leadership and Management Program: Taking Career Development Seriously (December 2002)
Joseph A. Ferrara and Mark C. Rom

The Influence of Organizational Commitment on Officer Retention: A 12-Year Study of U.S. Army Officers (December 2002)
Stephanie C. Payne, Ann H. Huffman, and Trueman R. Tremble, Jr.

Human Capital Reform: 21st Century Requirements for the United States Agency for International Development (March 2003)
Anthony C. E. Quainton and Amanda M. Fulmer

Modernizing Human Resource Management in the Federal Government: The IRS Model (April 2003)
James R. Thompson and Hal G. Rainey

Mediation at Work: Transforming Workplace Conflict at the United States Postal Service (October 2003)
Lisa B. Bingham

Growing Leaders for Public Service (August 2004, 2nd ed.)
Ray Blunt

Pay for Performance: A Guide for Federal Managers (November 2004)
Howard Risher

The Blended Workforce: Maximizing Agility Through Nonstandard Work Arrangements (April 2005)
James R. Thompson and Sharon H. Mastracci

INNOVATION

Managing Workfare: The Case of the Work Experience Program in the New York City Parks Department (June 1999)
Steven Cohen

New Tools for Improving Government Regulation: An Assessment of Emissions Trading and Other Market-Based Regulatory Tools (October 1999)
Gary C. Bryner

Religious Organizations, Anti-Poverty Relief, and Charitable Choice: A Feasibility Study of Faith-Based Welfare Reform in Mississippi (November 1999)
John P. Bartkowski and Helen A. Regis

Business Improvement Districts and Innovative Service Delivery (November 1999)
Jerry Mitchell

An Assessment of Brownfield Redevelopment Policies: The Michigan Experience (November 1999)
Richard C. Hula

San Diego County's Innovation Program: Using Competition and a Whole Lot More to Improve Public Services (January 2000)
William B. Eimicke

Innovation in the Administration of Public Airports (March 2000)
Scott E. Tarry

Entrepreneurial Government: Bureaucrats as Businesspeople (May 2000)
Anne Laurent

Rethinking U.S. Environmental Protection Policy: Management Challenges for a New Administration (November 2000)
Dennis A. Rondinelli

The Challenge of Innovating in Government (February 2001)
Sandford Borins

Understanding Innovation: What Inspires It? What Makes It Successful? (December 2001)
Jonathan Walters

Government Management of Information Mega-Technology: Lessons from the Internal Revenue Service's Tax Systems Modernization (March 2002)
Barry Bozeman

Advancing High End Computing: Linking to National Goals (September 2003)
Juan D. Rogers and Barry Bozeman

MANAGING FOR PERFORMANCE AND RESULTS

Corporate Strategic Planning in Government: Lessons from the United States Air Force (November 2000)
Colin Campbell

Using Evaluation to Support Performance Management: A Guide for Federal Executives (January 2001)
Kathryn Newcomer and Mary Ann Scheirer

Managing for Outcomes: Milestone Contracting in Oklahoma (January 2001)
Peter Frumkin

The Challenge of Developing Cross-Agency Measures: A Case Study of the Office of National Drug Control Policy (August 2001)
Patrick J. Murphy and John Carnevale

The Potential of the Government Performance and Results Act as a Tool to Manage Third-Party Government (August 2001)
David G. Frederickson

Using Performance Data for Accountability: The New York City Police Department's CompStat Model of Police Management (August 2001)
Paul E. O'Connell

Moving Toward More Capable Government: A Guide to Organizational Design (June 2002)
Thomas H. Stanton

The Baltimore CitiStat Program: Performance and Accountability (May 2003)
Lenneal J. Henderson

Strategies for Using State Information: Measuring and Improving Program Performance (December 2003)
Shelley H. Metzenbaum

Linking Performance and Budgeting: Opportunities in the Federal Budget Process (January 2004, 2nd ed.)
Philip G. Joyce

How Federal Programs Use Outcome Information: Opportunities for Federal Managers (February 2004, 2nd ed.)
Harry P. Hatry, Elaine Morley, Shelli B. Rossman, and Joseph S. Wholey

Performance Leadership: 11 Better Practices That Can Ratchet Up Performance (May 2004)
Robert D. Behn

Performance Management for Career Executives: A "Start Where You Are, Use What You Have" Guide (October 2004, 2nd ed.)
Chris Wye

Staying the Course: The Use of Performance Measurement in State Governments (November 2004)
Julia Melkers and Katherine Willoughby

MARKET-BASED GOVERNMENT

Determining a Level Playing Field for Public-Private Competition (November 1999)
Lawrence L. Martin

Implementing State Contracts for Social Services: An Assessment of the Kansas Experience (May 2000)
Jocelyn M. Johnston and Barbara S. Romzek

A Vision of the Government as a World-Class Buyer: Major Procurement Issues for the Coming Decade (January 2002)
Jacques S. Gansler

Contracting for the 21st Century: A Partnership Model (January 2002)
Wendell C. Lawther

Franchise Funds in the Federal Government: Ending the Monopoly in Service Provision (February 2002)
John J. Callahan

Making Performance-Based Contracting Perform: What the Federal Government Can Learn from State and Local Governments (November 2002, 2nd ed.)
Lawrence L. Martin

Moving to Public-Private Partnerships: Learning from Experience around the World (February 2003)
Trefor P. Williams

IT Outsourcing: A Primer for Public Managers (February 2003)
Yu-Che Chen and James Perry

The Procurement Partnership Model: Moving to a Team-Based Approach (February 2003)
Kathryn G. Denhardt

Moving Toward Market-Based Government: The Changing Role of Government as the Provider (March 2004, 2nd ed.)
Jacques S. Gansler

Transborder Service Systems: Pathways for Innovation or Threats to Accountability? (March 2004)
Alasdair Roberts

CENTER REPORTS AVAILABLE

Competitive Sourcing: What Happens to Federal Employees? (October 2004)
Jacques S. Gansler and William Lucyshyn

Implementing Alternative Sourcing Strategies: Four Case Studies (October 2004)
Edited by Jacques S. Gansler and William Lucyshyn

Designing Competitive Bidding for Medicare (November 2004)
John Cawley and Andrew B. Whitford

TRANSFORMATION OF ORGANIZATIONS

The Importance of Leadership: The Role of School Principals (September 1999)
Paul Teske and Mark Schneider

Leadership for Change: Case Studies in American Local Government (September 1999)
Robert B. Denhardt and Janet Vinzant Denhardt

Managing Decentralized Departments: The Case of the U.S. Department of Health and Human Services (October 1999)
Beryl A. Radin

Transforming Government: The Renewal and Revitalization of the Federal Emergency Management Agency (April 2000)
R. Steven Daniels and Carolyn L. Clark-Daniels

Transforming Government: Creating the New Defense Procurement System (April 2000)
Kimberly A. Harokopus

Trans-Atlantic Experiences in Health Reform: The United Kingdom's National Health Service and the United States Veterans Health Administration (May 2000)
Marilyn A. DeLuca

Transforming Government: The Revitalization of the Veterans Health Administration (June 2000)
Gary J. Young

The Challenge of Managing Across Boundaries: The Case of the Office of the Secretary in the U.S. Department of Health and Human Services (November 2000)
Beryl A. Radin

Creating a Culture of Innovation: 10 Lessons from America's Best Run City (January 2001)
Janet Vinzant Denhardt and Robert B. Denhardt

Transforming Government: Dan Goldin and the Remaking of NASA (March 2001)
W. Henry Lambright

Managing Across Boundaries: A Case Study of Dr. Helene Gayle and the AIDS Epidemic (January 2002)
Norma M. Riccucci

Managing "Big Science": A Case Study of the Human Genome Project (March 2002)
W. Henry Lambright

The Power of Frontline Workers in Transforming Government: The Upstate New York Veterans Healthcare Network (April 2003)
Timothy J. Hoff

Making Public Sector Mergers Work: Lessons Learned (August 2003)
Peter Frumkin

Efficiency Counts: Developing the Capacity to Manage Costs at Air Force Materiel Command (August 2003)
Michael Barzelay and Fred Thompson

Managing the New Multipurpose, Multidiscipline University Research Centers: Institutional Innovation in the Academic Community (November 2003)
Barry Bozeman and P. Craig Boardman

2004 PRESIDENTIAL TRANSITION SERIES

Government Reorganization: Strategies and Tools to Get It Done (August 2004)
Hannah Sistare

Performance Management for Political Executives: A "Start Where You Are, Use What You Have" Guide (October 2004)
Chris Wye

Becoming an Effective Political Executive: 7 Lessons from Experienced Appointees (January 2005, 2nd ed.)
Judith E. Michaels

Getting to Know You: Rules of Engagement for Political Appointees and Career Executives (January 2005)
Joseph A. Ferrara and Lynn C. Ross

SPECIAL REPORTS

Enhancing Security Throughout the Supply Chain (April 2004)
David J. Closs and Edmund F. McGarrell

Assessing the Impact of IT-Driven Education in K–12 Schools (May 2005)
Ganesh D. Bhatt

CENTER FOR HEALTHCARE MANAGEMENT REPORTS

The Power of Frontline Workers in Transforming Healthcare Organizations: The Upstate New York Veterans Healthcare Network (December 2003)
Timothy J. Hoff

IT Outsourcing: A Primer for Healthcare Managers (December 2003)
Yu-Che Chen and James Perry

BOOKS*

Collaboration: Using Networks and Partnerships
(Rowman & Littlefield Publishers, Inc., 2004)
John M. Kamensky and Thomas J. Burlin, editors

E-Government 2001
(Rowman & Littlefield Publishers, Inc., 2001)
Mark A. Abramson and Grady E. Means, editors

E-Government 2003
(Rowman & Littlefield Publishers, Inc., 2002)
Mark A. Abramson and Therese L. Morin, editors

Human Capital 2002
(Rowman & Littlefield Publishers, Inc., 2002)
Mark A. Abramson and Nicole Willenz Gardner, editors

Human Capital 2004
(Rowman & Littlefield Publishers, Inc., 2004)
Jonathan D. Breul and Nicole Willenz Gardner, editors

Innovation
(Rowman & Littlefield Publishers, Inc., 2002)
Mark A. Abramson and Ian Littman, editors

Leaders
(Rowman & Littlefield Publishers, Inc., 2002)
Mark A. Abramson and Kevin M. Bacon, editors

Learning the Ropes: Insights for Political Appointees
(Rowman & Littlefield Publishers, Inc., 2005)
Mark A. Abramson and Paul R. Lawrence, editors

Managing for Results 2002
(Rowman & Littlefield Publishers, Inc., 2001)
Mark A. Abramson and John M. Kamensky, editors

Managing for Results 2005
(Rowman & Littlefield Publishers, Inc., 2004)
John M. Kamensky and Albert Morales, editors

Memos to the President: Management Advice from the Nation's Top Public Administrators
(Rowman & Littlefield Publishers, Inc., 2001)
Mark A. Abramson, editor

New Ways of Doing Business
(Rowman & Littlefield Publishers, Inc., 2003)
Mark A. Abramson and Ann M. Kieffaber, editors

The Procurement Revolution
(Rowman & Littlefield Publishers, Inc., 2003)
Mark A. Abramson and Roland S. Harris III, editors

Transforming Government Supply Chain Management
(Rowman & Littlefield Publishers, Inc., 2003)
Jacques S. Gansler and Robert E. Luby, Jr., editors

Transforming Organizations
(Rowman & Littlefield Publishers, Inc., 2001)
Mark A. Abramson and Paul R. Lawrence, editors

* Available at bookstores, online booksellers, and from the publisher (www.rowmanlittlefield.com or 800-462-6420).

About the IBM Center for The Business of Government

Through research stipends and events, the IBM Center for The Business of Government stimulates research and facilitates discussion on new approaches to improving the effectiveness of government at the federal, state, local, and international levels.

The Center is one of the ways that IBM seeks to advance knowledge on how to improve public sector effectiveness. The IBM Center focuses on the future of the operation and management of the public sector.

About IBM Business Consulting Services

With consultants and professional staff in more than 160 countries globally, IBM Business Consulting Services is the world's largest consulting services organization. IBM Business Consulting Services provides clients with business process and industry expertise, a deep understanding of technology solutions that address specific industry issues, and the ability to design, build and run those solutions in a way that delivers bottom-line business value. For more information visit www.ibm.com/bcs.

For additional information, contact:
Mark A. Abramson
Executive Director
IBM Center for The Business of Government
1301 K Street, NW
Fourth Floor, West Tower
Washington, DC 20005
(202) 515-4504, fax: (202) 515-4375

e-mail: businessofgovernment@us.ibm.com
website: www.businessofgovernment.org