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NATIONAL SOCIAL SCIENCE TECHNOLOGY JOURNAL

Volume 5 #2

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Defeat the Technology Penalty with Innovative Expert Strategies

Harvey C. Foyle
Lawrence Lyman
Dusti Howell
Emporia State University (Kansas)

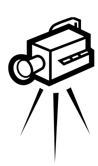
Abstract

Van Horn (2006) sounded the alarm about the technology penalty that educators pay in trying to keep up with the rapidly exploding changes in the technology field. The Instructional Design & Technology Department faculty at Emporia State University's (Kansas) teach pre-service teachers in two required technology courses as well as masters' degree courses. As a direct result of Van Horn's warning, the faculty sought relief from this onslaught of technological change. A team approach was adopted addressing this technology penalty. This technology team approach may be adopted by P-12 educators, too. Three specific strategies are used and can be followed by all educators who confront ever-changing technological growth.

Introduction

The science fiction writer, Heinlein, had a character state "A human being should be able to change a diaper, plan an invasion, butcher a hog, conn a ship, design a building, write a sonnet, balance accounts, build a wall, set a bone, comfort the dying, take orders, give orders, cooperate, act alone, solve equations, analyze a new problem, pitch manure, program a computer, cook a tasty meal, fight efficiently, die gallantly. Specialization is for insects" (Heinlein, 1973).

This sounds intuitively correct about human beings in general when comparing people to insects. However, educators interact with students who have technology devices and, thus, interact with the technology penalty of constant change. "I frequently write about the benefits, or payoffs, of technology. But what about the technology 'penalty'? The technology penalty is what happens when you do something using technology that you could do easier, quicker, or more efficiently without using technology. The way to deal with the technology penalty is to know that it exists, to expect it, to plan for it, and to document it. Administrators and others who want to integrate technology into education need to follow this advice" (Van Horn, 2006). How do educators find time to innovate - let alone keep up with constant changes? How can educators find ways to become efficient and save time so that they can be innovative? The answer is by doing exactly what Van Horn just mentioned. Technology can save time and effort but it also can kill a professor's time. Planning for technology penalties and documenting them is critical for succeeding in the current technological environment.

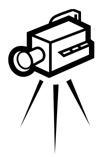


Accelerating Innovation in Education: Adam Frankel at TEDxBeaconStreet

The biggest penalty that the Instructional Design & Technology Department (IDT) faculty at Emporia State University (KS) has observed is that technology facilitates the development, creation and transfer of information at unprecedented rates. As educators march through the 21st century, information continues to grow at an ever-increasing rate. Data overload and dilution are reasons why people don't learn. "There is too much coming in. People either don't focus, or can't. The mass of data dilutes any one piece of it. We don't need more breadth, we need more depth" (Ruhe, 2008). How can professors plan to deal with this growing mountain of data so that they can gain more depth?

Expertly Divide And Conquer

"The engineers of the future will likely be 'T-shaped thinkers,' deep in one field but able to work across all fields and communicate well." (Murray, 2011) For professors, one way to gain more depth is by using a team approach. The faculty found it very difficult to keep up with technological changes that the pre-service teachers needed in their computer lab courses. A departmental team can mitigate the stress of change by each member focusing on one or two technological changes at a time. More specifically, the IDT faculty determined strategies to focus each professor's strengths and efforts in order to provide a focus for the department's programs and courses. Teams of educators (Foyle, 1995) individually focus upon one technological aspect and become the departmental 'expert' in that area. One team member focuses upon Photoshop and image editing. Another member centers upon Cloud Computing, its applications, and document storage. Another member concentrates upon multimedia in all its ramifications. Another member emphasizes visual literacy, robotics, and animation. Another member attends to learning management systems (Blackboard, Moodle, Canvas) and online quality. In addition, another member emphasizes the PC and Mac equipment and software changes.



Designing for the T-Shaped Thinker

Additional subject matter experts and tech support team members are a librarian who assists in obtaining educational technology research materials, a university tech support staff member who helps with online courses and new tech equipment, a teacher education professor who makes videos and webpages and uses them in pre-service teachers' classes (Lyman, 2013), and a departmental senior administrative assistant who provides support.

The IDT faculty does act as a team. It does integrate each member's specific skills and knowledge into a departmental whole that is focused on better programs and courses for pre-service teachers. When a team member needs something out of the ordinary or very specific in regard to changes in applications, computers, technology, and uses, the faculty member goes to the departmental 'expert' with the question. As a team, similar knowledge and skills are held in common, but also team members individually become specialized experts just as the 'T' metaphor by Murray (2011) implies. This helps to spread the load of the ever-changing aspects of technology and makes for a more manageable approach to change.

Filter And Focus On The Right Information

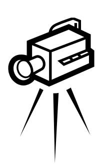
Educators need to be more selective of the information they pay attention to and manage. Focusing on information and filtering it through personal knowledge are useful approaches. Rheingold (2012) states "the first advice I would give unequivocally, based on my own decades online, is that in a world where information is abundant and veracity is not guaranteed, while gatekeepers, authorities, and fact-checkers are scarce, each of us as individuals and all of us as a society have no choice but to learn how to think critically about what we pluck from the information flow, how much we are to believe what we find or are given, and whether we should even devote any mind share to it at all" (p. 14). He recommends that educators have their ‘crap detectors’ set on high, to be skeptical of new information by thinking like a detective and verifying the information. Using technology, Rheingold recommends strategies that can help educators learn to make rapid micro-decisions about whether to pay attention to information by weighing the potential distraction against the goals they are focusing on. This decision dictates whether educators open a browser tab for later, or make a bookmark or begin verifying the information.

An interesting approach to adopting this strategy is the fact that more information isn't necessarily better. Gladwell (2007) tells of a controversial yet innovative decision to use less information in accessing emergency patients at one of the busiest hospitals in the America. Cook County Hospital in Chicago attempted to improve the accuracy for detecting heart attacks by limiting the information used. “We take it, as a given, that the more information decision makers have, the better off they are … but all that extra information isn't actually an advantage at all” (p.136). “It doesn't seem to make sense that we can do better by ignoring what seems like perfectly valid information” (p.138). They found that the expensive tests that took a lot of time to administer, added data that made diagnosis less accurate. Once they narrowed down their screening approach to a few ‘critical’ questions, detection and accuracy of heart attacks was improved greatly. Now most hospitals in America follow this counter intuitive approach. This approach is simply filtering and focusing upon the right technological information appropriate to the situation encountered.

Manage Your Digital Environment

With so many information streams coming at educators, it is imperative that they carve out an effective environment to work within. In this information saturated world with social networks like Facebook and Twitter pushing trillions of pieces of information a month into the digital ether, it is easy to get distracted. For nearly four decades, digital distractions have been growing. One former worker at Xerox PARC witnessed the first interruption by email. In the 1970's a visiting scientist was presenting a new multipurpose computer screen of the future when an email message popped up. He responded and then went back to his demonstration. One computer scientist angrily remarked that this was a terrible showcase of the future because these types of interruptions would kill the focus needed for scientific work (Seven, 2004). Years later it is noted that the demonstrator was multitasking. In 2005, a University of London study commissioned by Hewlett-Packard discovered that the constant interruption and distraction by email and phone calls lowered multitasking workers IQs by 10 points which was equivalent to missing a whole nights sleep (E-mails, 2005). Others disagree about multitasking. The bottom line is that it is not an efficient strategy to multitask. Educators should do their best to make sure that at least part of the day is spent without digital distractions.

Another highly relevant digital strategy to explore is the new productivity knowledge management tools and techniques (Young, 2010). These resources are a positive way to help manage the flow of information. Reference tools like Mendeley and Zotero can help educators become better technology explorers. These programs can ‘watch’ for targeted topics of interest, trusted experts, and informative journals, in order to make sure that key data resources and technological changes are not missed. Even more, these tools can pull highly relevant information to professors’ desktops so that as part of a team it will help them maintain the ability to stay relevant in today's information economy.



Adding References Using Mendeley

In conclusion, these strategies allow each team member to have time to innovate. The technology penalty can be overcome when professors communicate and share their specific skills and knowledge with each other rather than being in individual 'silos of knowledge' working alone.

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Collaboration to Create e-Textbooks for College Courses

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According to the National Digital Book Company, interactive digital books, also known as e-textbooks, "are the evolution of the textbook as we have known it, merging traditional textbooks with the most advanced electronic information and communications technologies available." (National Digital Book Company, 2015). This article will describe the collaborative and creative processes used by the authors to create two e-textbooks: a classroom management e-textbook and social studies e-textbook, for elementary education methods classes at the college level. (Lyman, et. al., 2010, 2015) The e-textbooks were created in collaboration with college faculty, teachers and administrators from Professional Development School sites, and elementary education college students.

Potential Benefits of e-Textbooks

Cost is often cited as a benefit of creating e-textbooks for use in college classes. In our classes, the cost of the e-textbooks we created is approximately half of the cost of the printed textbooks and classroom packets we previously utilized. There is also a benefit to the environment of saving the paper and materials used to produce print textbooks. Pogue (2013) points out that although e-textbooks usually cost less than print textbooks, students cannot resell the e textbook or donate it for reuse when finished with the e-textbook.

One of the most important advantages that e-textbooks have over traditional print textbooks is that they provide the student with an interactive, multimedia learning experience. Some of the resources available in e-textbooks can include audio and video content, search tools, and links to Internet resources. These advantages may improve the students' learning and liking for the course content.

E-textbooks offer instructors the opportunity to customize the design of the instructional materials which students will use in their courses and to provide content which is more up to date than traditional textbooks. In designing an e-textbook, the instructor can align the content of the book with the specific outcomes of the class. Study aids can be incorporated into e-textbooks which assist learners in understanding and applying the content they are learning.

Dobler (2015) cautions that students may feel overwhelmed by the choices offered by e-textbooks and how to utilize the e-textbook features effectively. Instructors using e-textbooks need to help students become familiar with the features offered by the e-textbook and model how to use these features. To get the most benefit from e textbooks, teachers need to utilize the collaboration tools offered by e-textbooks as part of the instructional design of their class.

Instructional Design of e-Textbooks

In designing e-textbooks for students, it is important to utilize components of effective instruction in presenting content, modeling strategies, and engaging the learner. Using a variety of materials and resources, critical and creative thinking, collaboration, and technology are especially important to consider in the design of an e-textbook.

One of the most important components of effective instructional design is to utilize a variety of materials, media, and resources to accommodate the different ways in which students learn. (Morehead, et. al., 2009) The potential of e-textbooks to utilize multimedia content and provide connections to a variety of resources and viewpoints allows instructors to model the use of such variety in the design of the materials students will use in their courses. This is especially important for teacher education students who will be planning their own lessons.

Effective instructional design also provides opportunities for students to think critically and creatively about what they are learning. (Lyman & Foyle, 2010) The content presented in the e-textbook needs to encourage students to think about what they are learning and how it might be applied in practical ways. Activities for engaging students in critical and creative thinking can be incorporated into the content students are interacting with. For teacher education students, it is especially important to model strategies for encouraging their own students to be critical thinkers and problem solvers. Assessments that are part of the e-textbook should be designed to measure how well the students understand the material, as well as the student's ability to apply the material in appropriate contexts in practical and creative ways.

Technology is another component of effective instruction that needs to be considered in the instructional design of an e-textbook. Technology can provide opportunities for students to acquire information through reading the text and related resources and from directed research. Technology can be also be used to help students practice skills or concepts from the course and for assessment. Having students use technology to create products that relate to the skills and concepts of the e-textbook is an important use of the technology opportunities provided by e-textbooks.

Effective instruction in postsecondary classrooms also requires opportunities for students to work collaboratively with each other and with the instructor. Cooperative learning provides opportunities for students to work together to understand the content and to construct innovative ways for understanding and applying the content. Cooperative classroom settings promote increased academic achievement and student ownership while providing opportunities to practice and enhance skills that are needed in the workplace. (Ventimiglia, 1995)

In the design of the e-textbook, cooperative strategies can be explained and modeled. In discussing the importance of the classroom environment for productive learning, for example, group building activities which engage the students can be modeled. Group building activities have the potential to create the group cohesion and mutual regard necessary for successful collaboration to take place. (Lyman & Foyle, 2010)

Creating an e-textbook that presents content in meaningful ways, models strategies, and engages the reader is a challenging task. The composition of the writing team brings together individuals who can bring different perspectives and skills to this process. Collaborating with colleagues in the public schools and with students in our classes is especially helpful in including a variety of materials, approaches, and viewpoints in the e-textbook.

The Writing Team

The process of creating a useful e-textbook is enhanced by collaboration among members of the writing team who bring specific background, insights, and skills to the project. To work together effectively, members of the writing team need to share a passion for the subject they are writing about, a compatible philosophy about teaching and learning, and mutual respect for the viewpoints and expertise of the other team members.

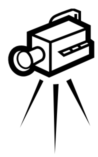
At the beginning of the process of designing and creating an e-textbook, the writing team needs to identify the content that will be included and the team members responsible for that content. It is important to establish timelines for completing tasks that the members of the team agree to and to hold the team members responsible for meeting those deadlines. The team should agree on a common format and style for writing to reduce editing and formatting at the conclusion of the project.

When writers work together on a project, the different voices of the respective writers can become an issue. The manuscript produced needs to be edited to address these issues. Members of the writing team need to be comfortable with the editing process and not take disagreements over content and editing changes as a negative reflection on their ideas or expertise.

The writing team for the e-textbooks we created included content and pedagogy experts who planned to use the e-textbooks for their university classes. An expert in instructional design and technology from the university setting helped the team deal with technology issues arising from including connections to Internet resources and multimedia content as well as strategies included in the e-textbook for students to use technologically effectively as future teachers. To assure relevance and accuracy of the content, a public school administrator with teaching experience at several grade levels was included as a member of the writing team. While each of the members of the writing team made excellent contributions to the e-textbook, collaboration with public school teachers and administrators and students in our university classes added to the usefulness of the content and strategies incorporated in the e-textbook.

Collaboration with PDS Mentor Teachers and Administrators

Professional Development School (PDS) partnerships provide an excellent structure for collaboration between university faculty and public school teachers and administrators. PDS models offer university faculty opportunities to spend more time in classrooms where mentor teachers are working with their students. Relationships can be nurtured with mentor teachers who open the way for collaboration in creating e-textbooks. (Morehead, et. al., 2009, 11-16)



Professional Development Schools at Illinois State

Mutual respect and trust are built during the many informal interactions which university faculty have with PDS administrators and teachers. As university faculty members interact with public school administrators and teachers, their ability to demonstrate empathy and positive regard for their colleagues as well as good listening skills, consistency, honesty, and respect for the ideas and expertise of their colleagues help to nurture the collaborative relationship. (Lyman & Foyle, 1990, pp. 24-37)

In the e-textbooks we created, one of the most important contributions of PDS building administrators was to make sure that videos and photographs from the school sites were created following district and building guidelines. Our e-textbooks feature photographs that were taken in PDS classrooms where our mentor teachers and interns were working with students. Administrators helped us secure permission from adult participants and from the parents/guardians of students.

Administrators provided content for our e-textbooks as well. For example, one administrator allowed us to videotape a math lesson he was teaching to third and fourth grade students. A counselor allowed us to videotape a lesson he was teaching to elementary students on bullying. The administrator of one of the PDS sites participated in a video interview about the impact of budget cuts in his schools. Another administrator participated in a video interview about the importance of extracurricular activities.

Mentor teachers working with our student interns at PDS sites also contributed content for the book. Several mentor teachers contributed lesson plans that were included in the e-textbook and which were aligned with appropriate standards. These lesson plans serve as excellent models for our teacher education students. Mentor teachers also allowed us to video record lessons they were teaching. One of the lessons we included featured an upper grade teacher modeling how to create a technology project for her class. Another teacher allowed us to video record lessons in which she demonstrated cooperative learning strategies with her students.

Mentor teachers also participated in video interviews. For example, one mentor shared the unique way she conducts home visits with her kindergarten parents. An upper grade teacher discussed some of the ways she changed the structure and physical arrangement of her classroom to accommodate the use of technology.

Collaboration with Interns

These e-textbooks have contributions from our students as they were working as interns in PDS classrooms. Interns shared lesson plans, some of which were included in the e-textbooks. Interns also shared graphic organizers that added appropriate additions to some of the content being presented in the e-textbook. For example, an intern shared her lesson plan for teaching about the Oregon Trail that was aligned to appropriate state social studies standards and included the use of technology in teaching the lesson. One of the graphics that we included was an intern's creative diagram of the components of a democratic classroom community.

Our e-textbooks also include videos of PDS interns teaching lessons to elementary school students. For example, one of our interns designed a creative health lesson using multiple intelligences and allowed us to video record the lesson. Another intern planned a unit on careers for third graders and allowed us to video record lessons from the unit. An intern teaching in a kindergarten classroom was videotaped teaching a math lesson and managing centers for the students.

Ancillary Websites

We have found that using Google sites to support our e-textbooks is helpful for the instructor and for the students in our classes. The Google website allows us to place support materials and study aids in a location that is easier to update than the-textbook. For example, on our ancillary website (https://sites.google.com/site/teachingsocialstudiesesu), students can find the PowerPoint presentations that support the content of the e-textbook. These PowerPoint presentations are often used in class and can be downloaded by the students if they would like to do so. Chapter questions and learning activities can be placed on the ancillary website which the student can complete after downloading the content.

An important benefit of a Google site that supports an e-textbook is that material can be updated and added on the site in advance of an update to the e-textbook. Resources and references that have been updated and accessed by students who have completed the class during an earlier semester can easily be accessed at any time.

Google websites can also be used for student projects that are completed as part of the class for which the e-textbook is being used. For example, in a social studies methods class, students are required to create a webpage which can be added to a website about geography sites . Lesson plans and ideas which were not included in the e-textbook can also be shared on a Google website. An example can be found at https://sites.google.com/site/creatingclassroomcommunities/.

Conclusion

E-textbooks have many potential advantages for students and instructors at the college level. Creating e-textbooks collaboratively with colleagues improves the quality of the content and encourages creativity in designing the instructional components of the e-textbook. The collaborative structure of the Professional Development School provides opportunities for administrators, mentor teachers, and interns to collaborate in the creation of e-textbooks as well.

E-textbooks can be supplemented by the use of Google Sites. The purpose for doing this on a Google Site is to provide updates, study aids, students' work examples and other materials to keep the e-textbook current between updates. Courses still can use traditional textbooks but can be enhanced using the most advanced technological approaches available in creating e-textbooks.

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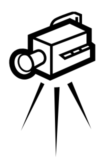
Retrofitting Instructional Strategies in the Math Classroom: Technology Becomes the "New Classroom Tradition"

Sydne Endorf
Judith Ruskamp
Peru State College

The classroom teacher of the twenty-first century is a classroom teacher challenged with a variety of new literacies that constitute an important understanding of new ways for a student to learn. In consideration of those new ways of learning and the effective instructional strategies that will result in student learning, it is important to note that no single instructional strategy is guaranteed to result in high levels of student learning (DuFour, Marzano, 2011). The old adage of "we've always done it this way," or a solid base for a research-based best practice regarding a particular teaching strategy could concomitantly be deemed ineffective as a result of its inability to successfully impact student learning. According to Marzano (2009), educators must always look to whether a particular strategy is producing the desired results as opposed to simply assuming that if a strategy is being used, positive results will ensue. The most important criterion in assessing the success of a lesson is whether or not students have learned (DuFour, Marzano, 2011).



How to Build a 21st Century Classroom

Retrofitting traditional classroom instruction to include the effective use of technological resources and media to enhance learning is paramount to the success of today's classroom. The twenty-first century student is the first generation to be immersed in information and communication technologies (ICT) for their entire lives, and this requires the creation of new literacies and new ways of learning. There are three tenets related to the judicious use of technological resources and tools:

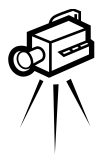
1. *Encourage critical reading and thinking.* When students use technological resources to answer questions or conduct research, they have access to a wide variety of sources of information, rather than merely a single textbook. This multitude of choices requires them to think critically about their sources, and to evaluate their validity. Teachers need to model this type of thinking for students, showing them how to select information and consider the appropriateness of the information provided by the source.

2. *Promote high-level thinking.* Because of the wide variety of information available through the use of technology, and the many ways that information can be used and manipulated, teachers can engage students' thinking in many more ways than in traditional classroom teaching. Among other things, students can conduct research using a myriad of different types of resources, participate in dialogue with people from all over the world, summarize the information they have found, produce their own texts and visual media, and analyze information and apply it to real-life

situations.

3. *Channel and scaffold.* Navigating the huge array of resources available can be daunting and even counterproductive. Teachers must channel their students in the direction they need to go as they learn from technological media. Choosing appropriate websites and creating webquests help to narrow the choices available on a particular topic. Scaffolding is also necessary, as teachers support their students with graphic organizers, note-taking guides, questions, models, and cooperative learning (Building Teaching Skills and Dispositions, My Education Lab, 2011).

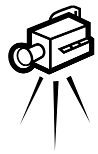
Concomitantly, teachers who implement and utilize technological tools and resources in their classrooms as part of their instructional planning, support the development of learners who are discriminatory thinkers and independent learners. According to Richardson (2013), "For the learner, these are exciting times" (p. 10). Today's classroom teacher needs to match that excitement with the facilitation of learning opportunities that can engage, channel, and nurture that excitement in a meaningful way. In the 21st Century, these "learning opportunities" must include the innovative use of new technologies. Most teachers use multiple strategies when it comes to using technology in their classroom, whether they realize it or not. For example, a math classroom is no exception. All math teachers use calculators every day for instructional purposes, along with other traditional forms of technology. However, according to Magana and Marzano, (2014), technology use in the classroom will become a "*Knowledge Revolution*," which will completely transform the structure of our schools (p. 5).



The 21st Century Classroom:Dr. Jackie Thomas at TEDxTomball

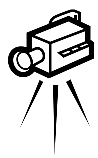
Many teachers in their classrooms and administrators in their schools, for that matter, have a myriad of opportunities to develop their delivery of content with the integration of technology into every lesson. According to Magana and Marzano (2014), "Edison predicted, 'Books . . . will soon be obsolete in the school. . . .' While Edison's prediction has not, as of yet, come true, the availability of educational technology continues to increase" (p. 3). Edison believed that all schools will retrofit the classroom to use only technology. Currently, no one school has been identified as having completely retrofitted its classrooms to accommodate the utilization of technology as the sole delivery of classroom content. Nonetheless, the capability exists for just such a learning environment. In Nebraska, for example, 53% of the 249 public school districts are one-to-one, according to the 2014 Nebraska Department of Education Technology Report. All students in these school districts are able to use the same iPad, Mac computer, or laptop for the entire year. That means that out of those 249, there are 134 public school districts that are one-to-one. In addition to the 134 districts that are one-to-one, there are 32, or 13% that are "bring your own device" in the state Nebraska.

Current research on the use of technology tools in the classroom has shown that there are multiple ways of retrofitting classrooms to successfully and effectively deliver classroom content and multiple tools to get you there. According to Pitler, Hubbell, and Kuhn (2012), there are nine different categories of technology that are used in the classroom in general. Word processing applications are not so "cutting edge" relative to technology use in the classroom today. Microsoft Word and Office, for example, are fairly commonplace in the classroom. Other tools, however, are not so common and include various learning management systems, organizing and brainstorming software, data collection and analysis tools, communication and collaboration software, and instructional media. All of these technology tools allow for organized thinking, connecting and categorizing ideas, and showing processes, as well as collection and analysis of data, and various tools used for communication for both the teacher and the student.



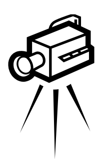
Marzano’s Nine Strategies for Effective Instruction

Teachers have become increasingly cognizant of the importance of implementation and utilization of strategies aimed at helping students “master” classroom content. One of the strategies is called *flipped learning*, where students access instructional videos and other resources at home and then come to class to practice what they have learned. Bergmann (2013) says, “Flipped learning is not about how to use videos in your lessons. It’s about how to best use your in-class time with students” (p. 16). Many teachers may automatically think about a video camera for preparing the lesson; however, flipped classroom videos of the teacher talking and showing examples of the instruction can easily be recorded with the use of a computer equipped with a camera without even showing the teacher’s face. If teachers give the students a fifteen-minute video to watch at home, then the teacher can spend most of the face-to-face time answering questions on the material. Many effective technology applications can be used when doing a flipped classroom.



Setting Up a Flipped Classroom

Blended learning, or hybrid learning, is another strategy that uses technology to help teach the students new material. According to Magana &Marzano (2014), blended learning is defined as instruction that combines online and face-to-face elements. Blended learning helps give the teacher and students more time to discuss the material and to answer questions, rather than spending most of the time lecturing. Blended learning can also be described as using interactive instruction. According to Pitler, Hubbell, and Kuhn (2012), “Well-made software programs allow teachers to choose which learning objectives students need to practice, offer sophisticated and seamless multimedia to keep the learner engaged, and provide immediate feedback and scaffolding in order to help students understand and practice a concept” (p. 174). Blended learning and interactive instruction are based on the same needs for the students and are powerful strategies in teaching that use technology as a supplement resource.

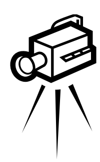


Blended Learning: Making it Work in Your Classroom

The math classroom is poised for the impactful implementation and utilization of technology as a mode of content delivery. For example, there are many iPad applications that can be used to retrofit math classrooms with the new technology. Show Me is just one of the many applications that can be used for flipped classrooms or blended learning. Other applications that can be used to help better basic math skills or note taking skills including “Rocket Math”, “Syncpad”, “DoodleToo”, “Notes”, “Evernote”, “AudioNote”, “Infinote”, and “PaperDesk.” Rocket Math is a free application that works with basic math skills, telling time, handling money, and identifying three-dimensional shapes (Pitler, Hubbell, Kuhn, 2012). Syncpad, DoodleToo, Evernote, AudioNote, Infinote, and PaperDesk are all applications that are used for note taking skills. Syncpad and DoodleToo are applications that “allow multiple students to collaborate by drawing, writing, and chatting" (Pitler, Hubbell, Kuhn, 2012, p. 82). Evernote, AudioNote, Infinote, and PaperDesk are each different applications that help students on their note-taking skills. Each of these applications uses different organization techniques to help the students take better notes.

Facilitation of a one-to-one initiative focused on device accessibility that allows for the implementation of so many powerful instructional tools and resources does not come without it challenges. Professional development related to training teachers to implement and utilize these technology tools and resources has to be an academic leader's priority in any school setting when it comes to retrofitting the classrooms with new technology. "Technology comes too fast, and a teacher isn't knowledgeable about it. They aren't really taught how to use them. There are time issues and it can be a distraction" (9-12 Math Teacher, personal communication, October 2014). This statement is exactly why teachers need multiple opportunities to get professional development in technology. According to Borko, Whitcomb, and Liston (2009), "Recent advances in digital technologies are having a strong impact on teacher education and professional development" (p. 5). The strong impact on teacher education and professional development makes an impact on how the students learn. If the teachers' knowledge of technology is not being expanded and supported by professional development, then how can teachers integrate technology into the classroom? Borko, Whitcomb, and Liston (2009) gave three of the most common professional development forms. The three main forms are "(a) video and digitized artifacts as a tool to provide a shared classroom experience in teacher education and professional development, (b) online social networks for educators, and (c) online professional development programs" (p. 5). Other forms of professional development include conferences from the following organizations: Nebraska Technology Association, National Social Sciences Association, and Nebraska Department of Education, and many others.

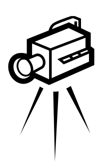
At the outset of this research project, the assumption was that classrooms, math classrooms specifically, don't utilize technology in the classroom as much as other subject areas do. The literature review, which focused on educational leadership in the area of technology as an instructional tool to enhance classroom instruction, suggested that there are many technology tools that can be used specifically in a math classroom. In an attempt to either confirm or disprove what the literature had conjectured, research data was collected utilizing a survey disseminated via SurveyMonkey.com, and interviews conducted with four math teachers and a specialist at the Nebraska Department of Education on the topic of implementation of technology tools as a vehicle for successful delivery and mastery of math content. Following the completion of the survey and interviews, an analysis of the data brought the research to its conclusion



Conrad Wolfram: Teaching Kids Real Math with Computers

The survey, disseminated to math teachers across the state of Nebraska, included nine questions related to three specific areas of discussion: what technology is used, how it is used, and the level of professional development that is committed to retrofitting the classrooms with the new technology. All of the classroom teachers were 7-12 math teachers, with a few of them teaching programming. All respondents noted that they use technology in the classroom. Calculators were the most presented form of technology with SmartBoards, computers, iPads, and supplemental websites also being utilized. About 50% of the respondents said that technology is often used as a management tool. However, 22.22% and 27.78% of the respondents said that they never or sometimes used technology as a management tool. The main reason for using technology in the classroom is for homework and assignments and for formative assessment purposes. One math teacher stated that "Technology does not manage the classroom, the teacher does. The technology is only for reporting issues" (7-12 Math Teacher, Personal Communication, December 2014). That statement not only says that technology is used as a tool for educational purposes, but also for communication. When the respondents were asked about how often technology is used as an instructional tool in their classrooms, 61.11% said often, with 16.67% and 22.22% saying sometimes and always. Technology has become one of the most utilized instructional tools. The level of professional development in the schools varies greatly. Thirty-eight percent of the schools rarely provide professional development seminars, while 72% of schools hold seminars one to three times per semester. With how fast technology is evolving, the concern is that one to three times per semester might not even be enough professional development to prepare classroom teachers to effectively respond to the need for effective and meaningful implementation of technology in the classroom.

Four teachers from various sizes of schools and a Nebraska Department of Education math specialist consented to an interview. The interviews for the four teachers consisted of eleven questions. Questions were related to what technology is currently being used in the classroom, how it is being used, and how much professional development related to the implementation of technology in the classroom is provided. All teachers said they use technology in some manner. The type of technology consists of calculators, SmartBoards, laptops, projectors, and ELMO's. The use of technology in their classrooms focused specifically on connection to enhancing classroom instruction; technology for classroom management and record-keeping was secondary. The professional development questions were based mainly on how often seminars are held to help inform the teachers of new technology that can be utilized in the classrooms. "Technology comes too fast, and a teacher isn't knowledgeable about it. They aren't really taught how to use it" (7-12 Math Teacher, personal communication, October 2014). One of the interviewees said, "There are weekly meetings that last an hour. Those meetings are mainly used for professional development to give us ideas of different technology supplements that we can use" (7-12 Math Teacher, personal communication, October 2014). Even though this specific school has weekly meetings, one hour each week still might not be enough. "The level of commitment to support of professional development for technology use in the classroom is good, but could always be better. It's difficult to make time and almost has to be forced" (9-12 Math Teacher, Personal Communication, October 2014). A math specialist at the Nebraska Department of Education was asked about what their role is when implementing technology into the math classrooms. "No one directly helps implement technology into the classrooms, but there is a lot of support for using technology" (Informed Expert in Education in Nebraska, Personal Communication, October 2014). The Nebraska Department of Education tries to inform teachers of the new technology updates by holding workshops. There is support for the teachers; however, it's hard to find the time to give proper professional development to the teachers.



[Empowering the Teacher technophobe: Kristin Daniels at TEDxBurnsvilleED]

In conclusion, Magana and Marzano (2014) said it perfectly: "Educational technology and effective instructional strategies when used together result in greater student achievement than when either is used alone. Technology tools have the power to enhance instructional strategies, increasing students' engagement, participation, and learning." (p. 149). If given the proper technology tools and instruction, the teachers can increase the knowledge and involvement of their students. The 21st Century classrooms can't be a classroom without technology use. While retrofitting the math classroom with the new technology is somewhat at odds with the what might have been previously perceived as the traditional method of delivery of math content, the research supports the conclusion that math teachers are cognizant of the fact that teaching with technology is the new classroom tradition. They are moving forward with planning and preparation for classroom instruction that is supported with the use of technology. Not lost in the research is the fact that in order to experiment with new technologies, classroom teachers need to be supported by their academic leadership related to provision for directed, timely, purposeful, and practical professional development related to the implementation of technology in the classroom. According to a 7-12 Math teacher, "I have tried different technology, but there are just some things that you can't learn with technology. It would be totally cool, and I would learn how to use it, but I think it would just become a fad" (Personal Communication, October 2014). It is a fact that while there are many different types of technology tools schools do invest in, simply because they become very popular very fast, these same technology tools end up "collecting dust" for various reasons. Even though some technology becomes just a fad, especially in math classrooms, teachers clearly want to learn how to use different technology supplements to positively impact student achievement. "Taking time to save time" is an important mantra when it comes to technology use in the classroom. Learning how to properly use new technology out the outset of its implementation helps the teachers spend less time learning during class, and gives more time teaching for impact. Pitler, Hubbell, and Kuhn (2012) said, "It is important to first design a quality lesson plan and then select the most appropriate technologies to support that lesson" (p. 221). Implementing and utilizing technology that fits best with the lesson, as well as being one that teachers are knowledgeable of and competent in utilizing in the classroom, is the best strategy for retrofitting the math classrooms, and any other content area classroom for that matter, with technology.

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Effectiveness of Online Learning:
How do Adaptive Learning Tools Improve Student Learning?

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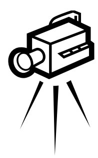
Abstract

This paper investigates the effect of a particular online adaptive learning tool on student learning outcomes. The study finds that the online adaptive learning tool is not a good predictor for exam performance in contrast to post-lecture homework. Moreover, pre-knowledge of the model is positively associated with understanding of the model. Furthermore, target score or accuracy of responses on the adaptive learning tool does not have any positive effect on exam performance. Rather, those who completed the first homework performed better than those who did not. However, causality could not be confirmed.

1. Introduction

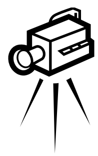
There has been a movement in higher education to increase graduation rate and to decrease cost. As a response, universities have adopted online courses or online components. This study focuses on a particular adaptive learning tool; *Learning Curve from Macmillan publisher*. *Learning Curve* is based on mastery learning and is used as a pre-lecture quiz. The conventional belief that preview benefits learning is tested. More precisely, this paper investigates if *Learning Curve* improves student-learning outcomes (SLO) as measured by midterm and final exam performance.



Learning Curve: Virtual Tour

2. Literature Review

Many studies capture the effectiveness of all or some combinations of online class, pedagogy, and students' ability (Carter, 2012; Debord, Aruguete, & Muhlig, 2004; Nochols, Shaffer, & Shockey, 2003; Pargas, 2006). (Brown & Liedhholm, 2002) use online quiz in online and hybrid classes that perform worse in exam than the cohort in a face-to-face class. (Foertsch, Moses, Strikwerda, & Litzkow, 2002) studies reverse teaching using web-based homework, which measures the effectiveness in one course of combining flip class with online component. They show that first, online class is as effective as face-to-face class and second, online course materials are as good as off-line course materials. (McGoldrick & Schuhmann, 2013) show that challenge quiz, which supports mastery learning, improves students' engagement in class. They also find an improvement of initial in class quiz and total quiz grade. (McKeown & Maclean, 2013) show that participation in online quiz, measured by time spent and the number of attempts, is a good predictor of final exam performance, but not online quiz grade. This study uses the total number of visits of lecture videos and durations of watching videos to reflect a student's effort. (Trost & Salehi-Isfahani, 2012) studied the effectiveness of *Aplia* in Principles of Microeconomics class with an experiment data from multiple instructors and in different universities. Their results show that *Aplia* as a post-lecture homework moderately improves midterm performance on related questions and does not affect final performance. Regarding *Aplia* homework grade as a binary variable (completed or not), one cannot measure how much *Aplia* homework grade affects learning outcomes. This study is similar to that used by (Trost & Salehi-Isfahani, 2012) in that topic-specific exam grade of selected four chapters is used. In the meantime, this study is different in some important ways. First, *Learning Curve* is used as a pre-lecture homework. Not only completion but also the number of questions answered, and the accuracy of responses will be used. This study uses Difference In Difference (DID) estimation to see whether or not the difference on exam grade stems from *Learning Curve*. DID makes it possible to include all the chapter performances. (Trost & Salehi-Isfahani, 2012) control for student characteristics, including SAT scores. SAT score does not demonstrate a significant performance in upper level economics courses (Laband & Piette, 1995). This study instead, uses *GRIT* score (Duckworth, Peterson, Matthews, & Kelly, 2007). Motivation and the degree of GRIT are positively correlated with long-term goals (Duckworth et al., 2007). Furthermore, students who are more self-disciplined (or self-motivated) are more likely to succeed (Duckworth & Carlson, 2013; Heckman, Stixrud, & Urzua, 2006; Segal, 2012).



4 Reasons College Students Love Aplia

3. Methodology

3.1 The Courses

The study targets one face-to-face and two hybrid classes of the Principles of Macroeconomics course taught by the author at an urban university with a diverse student body. 57% of students are full time students and working full time. 86% of participants said that the course is required. The face-to-face course has two 75-minute lectures per week while the hybrid course has one 75-minute lecture per week. Each course had 120 enrolled students. All courses being taught by the same instructor, there was no professor bias. Both face-to-face and hybrid courses used a flipped pedagogic method. To prevent any disadvantage attributed to the lack of face-to-face time, instructional videos containing explanations of course material including examples and practice questions were made available. Each video is on average 10-minute long and is posted on the Learning Management System (LMS) of all courses.

3.2 Experiment Design

Students were randomly assigned to a group on the first day of class. Group A can get credit for *Learning Curve* activities related to the 2nd, 4th, 7th, and 9th chapters. Group B can get credit for *Learning Curve* activities related to the 3rd, 5th, 8th, and 10th chapters. Both groups get credit for *Learning Curve* activities related to the Aggregate Demand and Aggregate Supply chapter.

Learning Curve is an adaptive learning tool; when a student does not answer a question correctly, *Learning Curve* asks another question about the same concept. When a student takes time to answer, *Learning Curve* nudges her an opportunity to see a hint. After seeing a hint, the student receives a lower score than the score without seeing hints. Students have unlimited attempts to reach a target score set by the instructor for each chapter. Once the target score is reached, the student receives full credit. *Learning Curve* questions are pulled from a question bank that is selected by the instructor at the beginning of the semester so that only class relevant materials are used.

4. Data

The data consists of exam grades for each chapter and student characteristics are derived from survey and observed data from 132 students in the hybrid course and 96 students in the face-to-face course. The mode of the data is described as a sophomore female student who is taking more than 12 credit hours per semester with a full time job. This student took one high school economics course, but none from college yet. She is required to take the course and to study 2 hours per week outside of class with 4 visits to LMS. Her GRIT score is 2.6 out of 5.

5. Findings

5. 1. Chapter-by-Chapter Analysis

This model uses DID estimation to estimate the impact of the adaptive learning tool, *Learning Curve* (***LC***), on the student learning outcome for each chapter, ***Y,*** measured by the percentage of the number of questions correctly answered in each chapter. Control variables are post-lecture homework, ***HW***, and a control variable, ***X***, which includes observed and surveyed student characteristics for student ***i*** and chapter ***j***. ***Group*** is a binary variable taking the value 1 for group A and the value 0 for group B.

$$Y_{i,j} = \beta_1 + \beta_2 \times Group_{i,j} + \beta_3 \times LC_{i,j} + \beta_4 \times HW_{i,j} + \beta_5 \times X_{i,j} + u_j + \epsilon_{i,j}$$

Table 1 shows that the adaptive learning tool, *Learning Curve*, is not associated with a positive effect on student learning outcome in contrast to post-lecture homework. One point, or 5-percentage point, increase in post-lecture homework score is associated with an increase of 0.50% in midterm, and 0.66% in final exam. Hybrid courses have a lower grade in midterm by 0.38% than the face-to-face course, but not for final exam. Due to the limited face-to-face lecture time in hybrid courses, the adaptive learning tool might replace face-to-face lecture time; therefore the adaptive learning tool would improve SLO in the hybrid course. However, the adaptive learning tool did not improve SLO.

This paper hypothesizes that group A, who completed Learning curve of chapters assigned to only group A, would perform better on those chapters. We will call it *group A chapters* (respectively, *group B chapters*) those chapters assigned to group A (respectively, B).

Table 2.1 shows students' performance in midterm exam and final exam of group A chapters. The coefficient of interaction term between *LC* and *Group* shows that adaptive learning pre-lecture homework does not have a significant effect on midterm and final exam performance. Rather, post-lecture homework does. 10-point or 50-percentage point increase in post-lecture homework score is associated with a 5% to 6% increase of each chapter grades in exams.

We should look at whether group A performs worse in group B chapters. Table 2.2 shows students' performance in group B chapters. There is no significant positive effect of Learning Curve on final exam performance. As was with group A chapters, post-lecture homework is associated with a positive and statistically significant relationship with exam performance in group B chapters as well. Group A still performs better in group B chapters on midterm (up to 22% better) and on final exam (up to 10% better). This might confirm that either the adaptive learning tool pre-lecture quiz does not improve exam performance or there are other unobserved effects. We will discuss this later in the paper. Hybrid courses have 6% lower grade in midterm of group B chapters. The same was not observed with group A chapters.

This study hypothesized that group A who completed adaptive learning tool for chapters assigned to group A would have better learning outcomes for those chapters, and group B would have better learning outcomes for group B chapters. Group A, who completed adaptive learning tool of assigned chapters, did perform better in the exam on those chapters. However, this cannot be attributed to the adaptive learning tool as the interaction variable of adaptive learning tool and group is negative, although is not statistically significant. Post-lecture homework is a better predictor of midterm and final performances. It was confirmed that the adaptive learning tool is a good predictor of post-lecture homework performance, although the result is not reported here. Also the results state that group A did better in group B chapters, and it is not thanks to the adaptive learning tool as the interaction term between the adaptive learning tool and group is negative.

5.2. Learning Curve Analysis

We have seen that *Learning Curve* with pass/fail grade does not have a positive correlation with SLOs. However, this does not say much about the target score, the number of questions, or accuracy of students' responses.

As the target score is set higher, students have to correctly answer more questions than before, offering thereby more chances for students to be exposed to concepts prior to lecture. *Learning curve* allows students to choose to answer more questions after they reach the target score as well. The result shows that target score does not have a positive effect on SLO. Interestingly, the number of questions answered by students has a positive effect on midterm performance, however the magnitude is small; 0.1% higher grade. This reveals an interesting aspect of human behavior; when the target score is set higher, students are forced to answer more questions to reach it, which does not improve their exam performance. However, when students voluntarily choose to answer more questions, one has slightly higher exam performance, however not statistically significant. It is likely that motivated students might choose to answer more questions. Ironically, accuracy of learning curve responses does not have any statistical significant effect on exam performance.

5. 3. Pre-Knowledge Comprehension

Aggregate demand is derived from the concept of Keynesian cross. One can test if the understanding of Keynesian cross would help in understanding the Aggregate Demand-Aggregate Supply model. Both group A and group B completed post lecture homework of the Chapter "Aggregate Demand and Aggregate Supply." *Learning Curve* activity on Keynesian Cross was made available to both group A and group B. However, only group B was required to complete the activity. We can test if group B has a better performance than group A in *Learning Curve*, post-lecture homework, and exams of Chapter of Aggregate Demand and Aggregate Supply.

Table 3 shows that group B did not necessarily perform better in Aggregate Demand and Aggregate Supply. However, regardless of the group assignment, those who completed *Learning Curve* of Keynesian cross performed better on post-lecture homework and midterm but not on final. This confirms that student's effort matters to a certain degree.

The hybrid course has a 9% lower grade in the exam on Aggregate Demand and Aggregate Supply. This chapter was the first chapter with diagrams in the semester. As hybrid courses have limited lecture time, students had limited exposure to visual examples of diagrams.

5. 4. Priming Effect

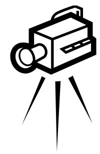
Group was assigned randomly on the first day of class. However, group A has 4% higher grade on final exam than group B in Table 1. First chapter *Learning Curve* was available to both groups, although it was not for credit. The first credit assignment, *Learning Curve* of second chapter, was due on the second week of the semester, and only group A was required to complete it. This created an unintended consequence; a priming effect on group A; group A had to put the course at their higher priority than group B. The average of homework completion rate was higher for group B. However, 90% of group A completed first post-lecture homework, which was due 2nd week of the semester, but only 83% of group B.

Furthermore, Table 4 shows the results of SLOs of students who completed *Learning Curve* of first and second chapter. Column (1) displays the results for students who completed first *Learning Curve*. As was expected, group A did not perform better. The same holds for students who completed second *Learning Curve* in column (3). Column (5) shows that there were no significant differences in SLOs for those who completed both first and second chapter of the Learning Curve. One can conclude that those students who start course assessments early in the semester tend to perform better. This effect is much larger in hybrid courses. In hybrid courses, group B performs worse than group A by 6%. However, among students who did not complete both *Learning Curve* of first and second chapter, group A records 13% higher final exam performance than group B.

This result cannot distinguish if an early assignment nudges students, leading therefore to better performance, or if motivated students complete the assignment, leading therefore to better performance.

6. Conclusions

Claims that Adaptive Learning tools help students' comprehension and improve students' learning outcomes are unsubstantiated. This paper finds no positive statistical significant effect of adaptive learning tool as pre-lecture homework on exam outcomes. Adaptive learning tool is based on a mastery learning, which improves post-lecture homework performances, however has limitation, as it did not show any positive effect on exam outcomes.



How Does Adaptive Learning Technology Benefit Students?

Using Keynesian Cross and Aggregate Demand, this paper shows that pre-knowledge of the model is positively associated with understanding of the model. This paper also finds that target score or accuracy of adaptive learning tool does not have any statistically significant positive effect on SLOs. First assignment is used as a nudge as those students who completed the first homework performed better than those who did not. Both results show that student's effort is important, however, causality cannot be confirmed.

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Appendix. Table

Table 1 Panel Analysis: Learning Curve on Midterm and Final

VARIABLES	(1) Midterm with all student characteristics	(2) Midterm with effort variables	(4) Final with all student characteristics	(6) Final with effort variables
LC	0.0008	0.0009*	0.0000	0.0002
	(0.001)	(0.000)	(0.000)	(0.000)
Post HW	0.0057***	0.0050***	0.0066***	0.0064***
	(0.002)	(0.001)	(0.001)	(0.001)
Hybrid	-0.3824***	-0.3736***	-0.0009	
	(0.032)	(0.019)	(0.025)	
Visit	0.0077***	0.0052***	0.0028***	0.0017**
	(0.001)	(0.001)	(0.001)	(0.001)
Duration	0.0474	0.0501	0.0376	0.0511*
	(0.044)	(0.042)	(0.026)	(0.026)
Group	0.0390*	0.0167	0.0677***	0.0424**
	(0.023)	(0.017)	(0.021)	(0.017)
Constant	0.6474***	0.5861***	0.6768***	0.5974***
	(0.087)	(0.030)	(0.078)	(0.016)
Observations	1,239	1,794	1,399	2,279
Number of id	140	227	140	228

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.1. Learning Curve on Midterm and Final: Group A Chapters

VARIABLES	(1) Midterm with all student characteristics	(2) Midterm with effort variables	(3) Midterm with effort variables	(4) Final with all student characteristics	(5) Final with effort variables	(6) Final with effort variables
LC	0.0010	0.0011	0.0011*	0.0000	0.0004	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
LC×Group	-0.0019	-0.0016	-0.0016	0.0003	-0.0004	-0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Group	0.0724	0.0565	0.0546	0.0495	0.0543*	0.0547*
	(0.051)	(0.044)	(0.044)	(0.034)	(0.028)	(0.028)
Post HW	0.0049**	0.0052***	0.0051***	0.0062***	0.0056***	0.0056***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Hybrid	-0.0189	-0.0174		-0.0009	0.0149	
	(0.036)	(0.023)		(0.025)	(0.017)	
Visit	-0.0015	-0.0019**	-0.0019**	-0.0000	0.0001	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Duration	0.0523**	0.0471**	0.0459**	0.0513***	0.0532***	0.0541***
	(0.023)	(0.022)	(0.022)	(0.019)	(0.019)	(0.019)
Constant	0.8306***	0.6374***	0.6265***	0.6897***	0.6082***	0.6166***
	(0.120)	(0.036)	(0.034)	(0.081)	(0.024)	(0.022)
Observations	280	454	454	560	912	912
Number of id	140	227	227	140	228	228

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.2 Learning Curve on Midterm and Final Group B Chapters

VARIABLES	(1) Midterm	(2) Midterm	(3) Midterm	(4) Final	(5) Final	(6) Final
LC	0.0030	0.0045***	0.0046***	0.0016	0.0009	0.0009
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LC×Group	-0.0048	-0.0052***	-0.0052***	-0.0014	-0.0005	-0.0005
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Group	0.2219*	0.1969***	0.1974***	0.1017**	0.0334	0.0337
	(0.117)	(0.065)	(0.063)	(0.049)	(0.033)	(0.033)
Post HW	0.0009	0.0039*	0.0041*	0.0034**	0.0015	0.0015
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Hybrid	-0.0685*	-0.0453*		-0.0025	0.0058	
	(0.036)	(0.026)		(0.030)	(0.020)	
Visit	0.0014	0.0019	0.0016	0.0000	0.0007	0.0007
	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Duration	-0.1763	-0.6748	-0.6956	0.6597***	0.3335**	0.3340**
	(0.556)	(0.512)	(0.519)	(0.199)	(0.162)	(0.162)
Constant	0.5787***	0.4556***	0.4235***	0.5719***	0.6472***	0.6502***
	(0.178)	(0.065)	(0.062)	(0.104)	(0.034)	(0.032)
Observations	140	227	227	419	683	683
Number of id				140	228	228

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Keynesian Cross on Aggregate Demand

VARIABLES	(1) HW ADAS_1	(2) HW ADAS_1	(3) HW ADAS_2	(4) HW ADAS_2	(5) Midterm ADAS	(6) Midterm ADAS	(7) Final ADAS	(8) Final ADAS
Group	-0.7471		-0.6986		0.0090		0.0139	
	(0.756)		(0.701)		(0.032)		(0.026)	
LC_Kynesian Cross		2.3260**		2.1072**		0.0711**		0.0276
		(0.906)		(0.830)		(0.032)		(0.030)
Hybrid	1.5261**	1.4573*	1.2703*	1.1813*	-0.0945***	-0.0938***	-0.0201	-0.0202
	(0.769)	(0.750)	(0.696)	(0.680)	(0.031)	(0.031)	(0.026)	(0.026)
Duration_ADAS	-22.2151	-15.5212	-27.0437	-20.7643	1.8140*	1.9566*	0.7561	0.7923
	(27.240)	(24.036)	(17.026)	(15.023)	(0.983)	(1.034)	(0.512)	(0.516)
Visit_ADAS	0.0326	0.0193	0.0380	0.0214	-0.0083**	-0.0090**	-0.0014	-0.0018
	(0.069)	(0.062)	(0.070)	(0.070)	(0.004)	(0.004)	(0.003)	(0.003)
Constant	14.8614***	12.8519***	14.5396***	12.7185***	0.5605***	0.5368***	0.4465***	0.4462***
	(0.799)	(1.050)	(0.725)	(0.930)	(0.064)	(0.058)	(0.048)	(0.044)
Observations	200	200	188	188	199	199	182	182
R-squared	0.185	0.204	0.138	0.176	0.309	0.316	0.382	0.381

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Priming Effect

	(1)	(2)	(3)	(4)	(5)
	Yes 1st LC	No 1st LC	Yes 2nd LC	No 2nd LC	Yes 1st & 2nd LC
VARIABLES	Final	Final	Final	Final	Final
Group	0.0265	0.0805***	0.0324	0.1313***	0.0256
	(0.020)	(0.029)	(0.020)	(0.044)	(0.022)
LC	0.0005	-0.0004	0.0002	0.0001	0.0005
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Post HW	0.0081***	0.0036***	0.0066***	0.0042**	0.0075***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Hybrid	0.0199	0.0278	0.0091	0.1343	0.0199
	(0.020)	(0.036)	(0.020)	(0.121)	(0.022)
Visit	0.0027***	-0.0001	0.0017**	0.0039**	0.0025**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Duration	0.0418	0.0954*	0.1208*	0.0230	0.1209*
	(0.029)	(0.057)	(0.066)	(0.031)	(0.067)
Constant	0.5408***	0.5842***	0.5728***	0.5097**	0.5460***
	(0.026)	(0.037)	(0.025)	(0.211)	(0.028)
Observations	1,569	710	1,779	370	1,399
Number of id	157	71	178	37	140

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Supporting K-12 Educational Reform Through Technology: Perspectives of K-12 Principals

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Abstract

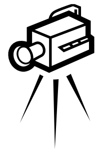
International Society for Technology in Education Standards for Administrators (ISTE-A, 2009) has been published for six years and but few studies have been done to indicate digital leadership indicators. This qualitative study aims to explore digital leadership performance indicators that support educational reform within the ISTE-A framework. Results showed that all principals considered technology as an integrated part of learning and teaching. Technology plan was reflected as an important digital leadership indicator. Hardware was reported as the basis of digital transformation. All principals mentioned professional development as indicator of digital leadership. Robust infrastructure and strategic partnership were suggested as good systemic improvement. Equitable technology access and resources as well as safe and legal digital environment were claimed as indicator of great digital citizenship.
Keywords: Digital leadership, ITSE-A, K-12

Introduction

The emerging instructional technology has significant effect on not only higher education but also K-12 classrooms. Technology has been defined as a must-do requirement instead of a preference or choice for 21st century learners. According to the Common Core State Standards (CCSS) Initiative released at 2009 and adopted by 45 states, K-12 students must be able to communicate, collaborate, produce, and publish their work by using technology with guidance from adults. The shift from learning about technology to learning with technology does not only require K-12 students but also K-12 educators to treat technology as an embedded part of teaching. Teachers need to adjust the ways of teaching so that students can meet the requirements of 21st century learning and CCSS. As school leaders, K-12 principals play a vital part in leading school transform from technology-referenced learning environment to technology-based learning community to meet 21st century learning requirements.

International Society for Technology in Education Standards for Administrators (ISTE-A, 2009) has been published for five years and numerous literatures utilized the ISTE-A standards to guide the studies. Most studies utilized ISTE-A standards as an assessment tool and investigated the relationship between technology leadership practices and school effectiveness including teaching, learning, and administration (Karnjanapun, 2013; Weng & Tang, 2014; Metcalf, 2012). However, few studies have been done to indicate specific leadership performance indicators within the ISTE-A standards. Since ISTE-A standards only provided descriptions of the expertise and responsibilities that school administrators should cover, researching the detailed digital leadership practices and providing concrete examples of successful digital leadership implementations are essential for K-12 school principals to understand and align their practices with ISTE-A standards.

This study aimed to investigate detailed descriptive digital leadership performance indicators within the ISTE-A standards. Digital leadership in this study was defined as using instructional technology, including digital device, service, and resources, to inspire and lead school digital transformation, create and sustain digital learning culture, support and enhance technology-based professional development, provide and maintain digital organization management, and facilitate and manage digital citizenship. School digital transformation was referred to the period of Common Core implementation. This study makes contribution to the digital leadership field by investigating and explaining qualitative digital leadership indicators that has not been addressed in previous literatures. This research provides K-12 principals with concrete examples of digital leadership that constituted with a series of successful practices and tips.

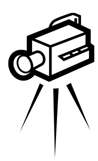


Digital Leadership:
Changing Paradigms for Changing Times

Literature Review

Research has demonstrated that digital leadership improves and encourages digital teaching and learning (Richardson, Bathon, Flora & Lewis, 2012). Principals' attitude towards technology affects teaching effectiveness and teachers' ability of integrating technology into teaching. Chang (2012) studied the relationship between principals' digital leadership and K-12 teachers' teaching effectiveness. Results showed that principals' technology knowledge and skills directly impacted on teachers' technology integration in teaching. Raman, Don, and Kasim (2014) also reported positive impact of principals' leadership on the use technology in teachers' classrooms. The study pointed out that principal worked as the role model in school's daily life and affected teachers' behaviors through their interaction.

Currently, there were no clear descriptions of what elements can be used to indicate successful digital leadership. Chang (2012) chose Principals' Technological Leadership Instrument that categorized digital leadership as vision, professional development, infrastructure support, evaluation, and communication. Garcia (2014) considered digital leadership as familiar with technology, use information retrieval, communicate with stakeholders, and manage resources. However, Chang's (2012) and Garcia's (2014) categories did not include all the elements, such as digital citizenship. Duncan (2011) contained all necessary elements by utilizing the Principals Technology Leadership Assessment (PTLA) as the research instrument to describe principals' digital leadership. However, PTLA instrument was developed from previous ISTE-A standard that was known as NETS-A standards (2002). It is not appropriate to use a ten-year old instrument to describe today's digital leadership. There was a need to explore what indicators can be used to describe today's digital leadership.



Innovative Teaching and Learning:
Lessons from High Tech High's Founding Principal

Purpose of the study

The purpose of this study is to explore digital leadership indicators in the context of K-12 education based on the International Society for Technology in Education Standards for Administrators (ISTE-A). ISTE-A was utilized to develop research questions and data collection instrument. This case study fills in this gap by observing, interviewing, and describing K-12 principals' digital leadership practices in real school settings and providing digital leadership indicators within K-12 context. According to ISTE-A standards, digital leadership was conceptualized as inspire and lead school transformation through technology, create and sustain digital learning culture, support technology-based professional development, provide digital leadership and management, and facilitate and manage social, ethical, and legal issues. The following research questions were proposed to guide this study:

1. What are the indicators of inspiring and leading school transformation through technology?
2. What are the indicators of creating and sustaining digital learning culture?
3. What are the indicators of supporting technology-based professional development?
4. What are the indicators of providing digital leadership and management?
5. What are the indicators of facilitating and managing social, ethical, and legal issues?

Method

Setting

The research setting was three K-12 schools (labeled as school A, B, and C) located at a southern town in Mississippi. School A served over six hundred students from grade two and grade three. School hours of school A was from 7:40am to 2:20pm. School B had more than eight hundred students who were kindergarten and grade one students. Students stayed at school from 7:40am to 2:10pm at School B. About five hundreds student from grade nine to grade twelve enrolled in school C, which was a high school. Student at School C stayed at school from 8am to 3pm. All of the three schools were located at the same school district.

Most of the technology support in the three schools came from the technology department of the school district. They shared one instructional technologist with each other. Schools can send technical support requests directly to the instructional technologist through email, phone calls, and district help desk. Then instructional technologist would schedule training time and days with the schools based on the requests.

Participants

Purposeful sampling method, primarily criterion sample was used in this study to gather information-rich feedback from individuals. Criterion sampling means selecting individuals who met a specific criterion. Criterion for this study was people who were in-service K-12 principals. Participants were recruited from the local K-12 schools with help of the technology director in the technology department of the school district.

The participants in this study were three K-12 principals who served in the school district more than five years. These participants were chosen because they could provide rich information regarding digital leadership and how technology influenced their leadership and the campus. For the purpose of privacy protection, pseudonyms were used throughout the date collection process whenever possible, with all transcripts utilizing only pseudonyms. All names used in this study were fictional names.

Data collection and analysis

A qualitative case study formed the methodological framework in this study to address the research question. Qualitative research methodology was well suited for this study to explore real-life experiences within a unique context through detailed and in-depth data collection involving interviews (Creswell, 2013; Seidman, 2012; Yin, 2013). In other words, qualitative rather than quantitative research methodology was more suitable to explore learning experiences because qualitative research focused on in-depth understanding of principal's digital leadership experience instead provided treatments of specific issue. Three types of data collections were conducted in this study: (1) in-depth interviews, (2) participants' observations, and (3) documents analysis.

Participants were interviewed with twelve open-ended questions that aimed to explore principals' digital leadership experience. Each participant was interviewed no more than one hour. During the interview, the researcher listened to principal's real-life experience related to digital leadership, learned about their feelings in the process of performing digital leadership, and understood their beliefs from the subjects' point of view. Participant observations were conducted in classrooms and computer labs. The relevant documents, including lesson plan, syllabus, school handbooks, district handbooks, and ITSE-A standards were collected and analyzed. Reviewing the related documents helped researcher gain a clear idea of digital leadership implementation. Data analysis and interpretations were conducted through (1) coding interviews transcriptions, observation notes, and documents analysis notes, (2) reading all data and generating categories, themes, and patterns, and (3) writing the findings according to the research questions.

Results and Discussion

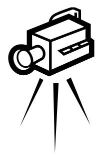
The findings and discussions of this study were organized around the research questions outlined earlier.

1. What are the indicators of inspiring and leading school transformation through technology?

Technology is an integrated part of learning and teaching. All participants reported that they realized technology was part of today's life. Technology means digital administration, digital learning, and digital teaching. Students are growing up with technology. It was impossible to move technology off the campus. It is necessary and important for schools to provide digital learning opportunities and help students get the digital learning experience. Principal A said, "We should connect the kids with the digital world where they are coming and growing." One of the teachers described her experience of using technology in her classroom, "I type the words at the bottom of movie. Students take iPad home. They can see the words on the bottom, hear them, and their language could be developed even faster. I also have blogs. Sometimes students do homework on my blog. They have to write a sentence whatever they're studying. Once students are excited of technology, they become exciting and their emotions are higher and they learn more. It's wonderful engagement."

Technology needs support from all stakeholders. Providing digital learning environment is an impossible task without support from all stakeholders. Principal A mentioned that, "all teachers are required to attend routine technology meetings in which a district technology liaison comes and updates each department of teachers on current technology in the district. The vision for technology at school is to ensure that technology is incorporated into all classrooms to enhance student learning. Upon completion of the required routine training, teachers work within their departments to ensure that students are exposed to a technology rich classroom." In addition, all principals realized the importance of Parents and Teachers Organization (PTO). PTO plays an important role in creating digital learning environment. Principal B said, "PTO in our school helps us switch from PC to Mac. They purchase Mac and voluntarily help us with computer class." Principal B said, "We have parents night and grandparents night. We use PhotoStory to make movies such as fairytale and alphabet story. For students speak different language, we can simply for them to practice and learn new vocabulary." At the very beginning of the year, schools performed an assessment of what the school needs, principals worked closely with the boards. They worked together to find out what schools needed and what teachers in classrooms needed. Principal C mentioned, "As the year moves on, I identify a big goal, which is to replace the technology last year and to update software that is used for interactive whiteboard. All of our small fund-raisers are gear towards raising money for that. So as long they can see, they will impact the instruction, help teachers with their instructional strategies, then they are on board. Make sure parents know what you are doing in school and try to be transparent. That's the key." Principal C added, "They donate money. Our largest funding raising is cash dash, which is the name of one funding raising activity. Students walk around labs, they donate the number of the computer that they walk around. It's fun because we play music and I run with them. We all participated. We reach out the community and everybody get involved." To help students and parents better prepare for digital learning, all students and teachers are responsible for reading the district handbook and policies and sign a technology agreement. This agreement is put in place to ensure students, faculty, and staff understand they are responsible for appropriate responsible use of technology. While responsibility is stressed, continued use of cutting edge, innovative technology is encouraged to ensure that schools remains a successful, top rated school in student technology. Principals requested that they had a lot of educational freedoms to do what was best for students.

In conclusion, to successfully inspire and lead schools' digital transformation and meet the requirement of visionary leadership, awareness of digital management and support from all stakeholders are two important factors that K-12 principals need to be equipped with. Principals first need to realize the importance of technology so that they can model the use of technology in school management and help all stakeholders see the benefits of digital environment. Parents and teachers are easier to accept and choose digital learning and teaching environment after they see and feel the value of technology. For instance, providing opportunities of accessing digital learning environment for parents is a good strategy to promote digital leadership. Requiring teachers attend necessary training also is important for teachers to understand how students can benefit from digital learning environment.



Innovative Digital Learning Environments

2. What are the indicators of creating and sustaining digital learning culture?

Hardware is the basis of digital transformation. Hardware equipped with appropriate software makes learning and teaching faster and easier. All participants shared with researcher that Wifi was covered in the whole campus for years. Schools encourage students to bring their own devices such as smartphone to school for instructional purposes. All schools have at least two computer labs. Instructors and students need to schedule the lab before have class there. Each classroom is equipped with an interactive whiteboard. Flip charts are saved for class review. Instructors also can share their flip charts and are able to modify the file to accommodate future instruction. Each instructor is equipped with a MacBook. Library is equipped with computers and a technology specialist. Students are able to use the library resources such as computers. High schools have a consulting center that helps students with their college application, SAT, and other instructional needs. iPad is used to manage students' behavior, share info with parents, and evaluate teaching.

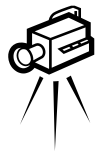
Modeling technology through administration activities. Principal models the technology use such as show how specific software or apps use in teaching and administration. In addition, principal from school B promoted using Twitter as a way of communicating with teachers and students. Teachers are required to update their teaching website based on parents' and students needs. If parents prefer paper-based materials, instructors can mail the materials such as hard copy newsletter. If parents prefer digital resources, teachers will upload materials such as lesson plan, newsletter to their teaching website. In addition, social media such as Facebook is used to share info with teachers and parents.

Utilization of available resources promotes digital transformation. All principals emphasized that student achievement was an important priority. Therefore, many strategies and technology were used to ensure that the diverse needs of all students are being met. The following list is an example of technology tools used in schools.

Plato-students use this technology software as a tutorial for credit recovery. As the student progresses through the program, the program adjusts to the process mastery of the student.

USA Test Prep-students use USA Test Prep for reinforcement review in preparation for SATP Test. Similarity to Plato, USA Test Prep also adjusts to the progress mastery of the student.

Edgenuity-computer software used for instruction at the Alternative School level. this program is designed to meet the needs of students to ensure that when the student returns to the regular school environment gaps in instruction will be minimalized. Additionally, Edgenuity will be implemented into the regular education curriculum to reinforce Core Curriculum, Concept and Credit Recovery, Instructional Services, Career Education, Higher Education, Summer School Programs, and Advanced Placement.

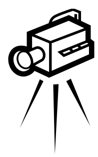


Edgenuity: The Educator Experience

ICAP-Career Readiness software used with all students on campus to ensure students are prepared to transfer from high school to college or from high school to a career.

Driver's Education Online Tutorial-This online tutorial site is used among students to review road signs, symbols, and traffic laws as they pertain to the state of MS.

Bookflix-it is an interactive book software program. It provides fictional books for kids. The computer tells the story and the book is animated. It also provides non-fiction pdf books for teachers.



Using Bookflix

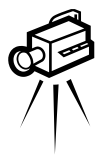
Creating and sustaining digital learning environment is the most important thing for schools. Digital learning environment indicators include digital resources and technology modeling. Providing necessary hardware is the basis of digital learning. If students do not have access to devices, digital learning does not exist. For instance, if schools do not have Wifi, students and teachers can do nothing with the computers. The money spent on the devices is kind of waste. In addition, teachers and students need to learn how to use technology besides just copy the information from books to computer. Showing the same information from the books is not using technology. Principals can demonstrate the value of technology through the daily interaction with the teachers. For example, showing how teachers are evaluated through iPad can help teachers see actual examples. Teachers would consider how she can use the same technology to evaluate her students.

3. What are the indicators of supporting technology-based professional development?

Professional development doesn't just mean training. Principal A said, "Teachers are not evaluated by the training they participated. I take pictures and also record the class as evidence in my phone and iPad. With the app in iPad, I can leave comments to specific teacher and also teacher can see the comments and get feedback immediately." Latest technologies are delivered to teachers via e-mail, district trainings, and software companies. Teachers can view the technology list and decide what they want to learn and when they are available to learn. Supporting teachers based on their needs is more important than affording teachers what schools have.

Build learning community to promote communication and collaboration. Teachers can request learning group after school time. Teachers stay at school and learn from other teachers and support each other. District also provides support for teachers. Teachers can report the technology they want and need. Then instructional technologist learns the technology and trains the teachers. District also shares technology such as software, app, and technological services with schools. Teaches are required to complete various online subject area trainings and district trainings. The subject area technology trainings equip teachers with strategies to use in the classroom that promote higher level thinking skills and problem solving skills in students. All the teachers are required to attend technology meetings during their planning periods. Instructional technologists are on hand during the professional development meetings to support teachers with the various technologies used in their classroom. Instructional technologists inform teachers of any update that they need to be aware of regarding the equipment in the classroom. The instructional technologists also answer questions and demonstrate how the various technologies can be used to increase student knowledge and achievement in the classroom. Routinely all administrators, teachers, and staff are involved in communities that promote and encourage the use of technology to improve school communication and productivity. All school communication currently in place is routinely updated with all school personnel. Principal from Oak Grove lower elementary uses Facebook as a way of communication and collaboration. She posts info there and parents' followers are able to see these info. She is promoting the use of twitter in her school. She uses technology such as SchoolStatus to collect evidence of teaching and administration. She takes pictures and records when she observes class. For parents, they will get a text reminder if school have event. Communication between school and parents is text-based communication because this way is simple and quick.

Principal B added, "We do group planning. Teachers would go descriptions and search resources and put links in lesson plans. We have those resources shared on the Google Drive. So when the links go on there, you just click on the links and open up the lesson plan. The links will take you straight to that resource. Google drive is really important. It enables us have access to and edit the documents at the same time. We also have shared drive in school district. It is called s-drive. Inside the s-drive, we have created different folders. One is for school. In school folder, we have first grade folder and kindergarten folder. We add new things there every year when we are planning and doing new things. Teachers collaborate to prepare classes by using Google docs, email, and Pinterest. Teachers can see what other teachers pin and principals start to follow other teachers."



Pinterest for Teachers

Principals also provided opportunities of collaborating with external organizations. Principal A said, "Teachers will go to local conferences to learn technology and present it when they come back. In addition, teachers need to renew their Continuing Education Units (CEU) each five years. They need to go conference or other activities to get their ten CEUs. Technology specialists from the device company such as Promethean Board Company sometimes come and train teachers. In addition, schools cooperate with universities to get support of technological trainings. Teachers are also able to go university and learn new technology while teachers from university come to our campus and present technology info to teachers." One of the teachers demonstrated principals' successful leadership and said, "I am the member of CISCO Company, whose main goal is to connect people to the Internet. They give school huge grant and provide training. They come to school and train teachers. Send teachers to national technology conferences. Teachers learn those tools and how to use those tools at the technology conferences. It is very beneficial."

Practical professional development and digital learning community are two indicators of excellence in professional practice. Providing professional development opportunities does not mean asking teachers to participate in the trainings. The point is to ensure teachers can get practical information from the professional development opportunities. If teachers cannot take things from the professional development opportunities, then it is waste of time for teachers. One strategy is to work with the trainers to ensure the trainers are offering the things teachers want and need. Digital learning community is not only important for students but also is a great way for teachers to communicate and collaborate. Learning community provides teachers an opportunity of sharing information and learning from each other. For instance, teachers can share their experiences of using specific tools or apps. Teachers who are not good at technology may want to try after they hear from their colleagues. Learning community does not only mean face-to-face talking. Effectively using social media such as Twitter can get more stakeholders involved. For example, sharing digital resources at Twitter so that everyone in the community can see it. The more opportunities teachers getting involved in digital learning environment, teachers are more likely to improve technological skills.

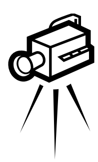
4. What are the indicators of providing digital leadership and management?

Purposefully maximize learning achievement through appropriate use of technology. All principals reported that they provided learning devices such as interactive board to ensure students and teachers are involved in digital learning environment. All schools have purchased chrome books and ebooks that all students are able to access. SAMS7, which is a management app, is being used to manage all attendance, tardiness, registration, scheduling, discipline, and absences. The technology plan is sustained by employing personnel to handle attendance, registration, scheduling, and computer lab tutorials. The financial support for the personnel is allotted through district budget. Principal uses Feedback, which is a digital management app, to collect evidence and comment teachers' instruction. She goes to school with her walky-talky, phone, and iPad everyday. Teachers and administrators use Google docs to share document such as lesson plan. Principals improve staff performance and student learning by collaboration.

Recruit and retain highly competent personnel to advance academic and operation goals. Teachers who are proficient at technology will model their technology and help with inside training. They also can get financial reward such as salary increase. The use of technology is assessed and evaluated through lesson plans for student learning and reports from SAMS for communication and productivity. Excel is used to analyze data and interpret the results. The findings are shared with teachers via e-mail. Teachers also use School Wires to communicate with student's families. SchoolStatus and Feedback is used to manage, evaluate, and assess operational systems.

Establish and leverage strategic partnerships to support systemic improvement. Teachers share flip charts with each other. After school time, teachers communicate, discuss, and learn with other teachers. Teachers learning group is built to promote communication and collaboration. Principal C reported that her campus was in the process of slowly replacing all technology. Chromebook has been ordered as well as desktop computers. School website has all the information of teachers, parents, and administrators. All the teachers are listed in the school website. Students and parents are able to access teachers' websites and instructional resources. Parents can get students' attendance report, PTO information, registration, transportation, and students' handbook information.

Maximized learning achievement, competent personnel, strategic partnership, and robust infrastructure are indicators of systematic improvement. Technology should be embedded in organizational development so that digital leadership and digital learning can be accepted and supported by all the stakeholders. For instance, giving reward to the highly competent persons and making school administration apparent are suggested strategies by all the principals.



Eric Sheninger: Digital Leadership

5. *What are the indicators of facilitating and managing legal, social, and ethical issues?*

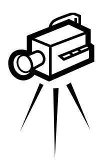
All principals reported that everyone had equitable access to resources. All learners have access to computer labs and library computers at all times. Teachers have access to computers in their classrooms via laptops and desktop computers. Schools also provide free digital resources for parents who do not have access at home. Principals use digital tools to provide a safe and legal digital learning environment. All students and teachers will sign a technology agreement form in which they agree not to do anything unlawful with technology. Additionally, filters are installed at all schools to ensure that students do not access inappropriate web sites.

Technology agreement form and filter are indicators of digital citizenship. According to the participants, most digital citizenship support comes from school district. None of the schools in this study have reported digital leadership related to digital citizenship. All the schools rely on school district such as the filters. Digital citizenship performance in schools is in low level. In addition, most digital citizenship performance focused on legal use of technology. For instance, provide technology usage guidelines for students and teachers to make them aware of dos and don'ts in digital learning environment.

Conclusion

This qualitative study investigated the indicators of digital leadership based on the ISTE-A standards. Three K-12 principals were interviewed with in-depth questions and results showed that principals in digital age should be able to inspire and lead school transformation through technology, create and sustain digital learning culture, support technology-based professional development, provide digital leadership and management, and facilitate and manage social, ethical, and legal issues. Indicators of digital leadership constitute awareness of digital leadership, support from all stakeholders, digital resources, technology modeling, practical professional development, digital learning community, maximized learning achievement, competent personnel, strategic management, robust infrastructure, technology agreement form, and filters.

With continuous influence on education, technology is part of today's learning. Principals should not ignore technology integration into K-12 learning and teaching. The role of the principal has changed from solely a school administrator to the multi-faceted role of curricular and technological leader. Principals should guide teachers to improve their technological literacy, teaching effectiveness, and students' academic achievements through technology. Effective communication and collaboration also improve the effectiveness of leading educational reform and enhance learning and teaching. This study acts as a reference for K-12 principals regarding digital leadership application in K-12 schools. One important thing for principals to remember is that while supporting technology integration and carrying out digital leadership, they should not only focus on hardware. It is important and necessary to provide teachers with hands-on resources that they can use in their classrooms immediately.



What is Digital Citizenship?

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