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Technology Integration: PDAs as an Instructional and Reflective Tool in the Science Classroom

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Abstract

The role of technology has an increased emphasis in the PK-12 classroom and in the preparation of teachers. The wide support for the integration of technology in day-to-day instruction is evidenced at many levels and through many organizations. The current study focused on examining and describing the experiences of faculty and interns as they relate to the use of the PDA. Results indicate that a clear and effective purpose for technology that matched specified outcomes was key for all of informants in this study. Results also indicated that the simplest, most efficient technology for a particular task was essential.

The role of technology has an increased emphasis in the PK-12 classroom and in the preparation of teachers. In fact, the wide support for the integration of technology in day-to-day instruction is evidenced at many levels and through many organizations such as National Educational Technology Standards project (NETS), the National Science Teachers Association (NSTA), the National Education Association (NEA), and the American Federation of Teachers (AFT; Settlage, Odum, & Pedersen, 2004). More specifically, the National Council for the Accreditation of Teachers (NCATE) and the International Society for Technology Education (ISTE) have indicated a specific set of skills and knowledge that all teachers must acquire in teacher preparation programs (Gilbert et. al., 2004; ISTE, 2002). The NSTA (2003) *Standards for Science Teacher Preparation* indicate,

> Candidates should know how to use appropriate technology including, but not limited to, computers and computer peripherals, both to enhance learning and to relate the use of technology to science. The ability of students to use technological tools is becoming increasingly important for collecting and processing data; and for presenting and disseminating the results. In addition to using technology in the science classroom, teachers should also ensure that students understand the role technology plays in professional science. (p. 12)

All teachers, including science teachers, should acquire the knowledge and skills necessary to integrate technology effectively into their classrooms.

The explosion of digital technology has created a revolution similar to the "hands-on" movement of the 1960s (Flick & Bell, 2000). Yet, little has changed since 1989 when the Office of Technology Assessment (OTA) suggested that as many as two thirds of graduating teachers have insufficient preparation relative to effective integration of computer-based technologies into their future classrooms (Scrogan, 1989). Pedersen and Yerrick (2000) confirmed this view and further showed that science educators feel a lack of preparation and understanding with respect to addressing the needs of students in technologically emergent classrooms. In the past, part of the problem with technology integration could be traced to the lack of development for classroom settings. Rather, most technology (and software) was developed for business applications.

However, there has been a “mini-revolution” in the development of microcomputer innovations and appropriate instructional resources for teachers. Teachers no longer need to adapt business-type technology for use in their classrooms. Developers are creating user-friendly tools that promote inquiry and engage students to think beyond basic skills. Once teachers become comfortable with the use of these learning-focused technological tools for inquiry, they can (a) offer their students opportunities to examine current ideas in science, and (b) teach the actual processes of science and the tentative nature of scientific answers (Pedersen & Yerrick, 2000).

Personal digital assistants (PDA) represent one example of the new technologies being touted by some educators as tools for inquiry. PDAs have many promising attributes that could make them ideal for use in science classrooms. They are compact and portable, allowing for use in various settings including outside of the classroom. Most offer user-friendly interfaces that allow teachers and students to exchange data and add useful tools for data collection (e.g., temperature probes). PDAs appear to be more cost effective than personal computers (PCs), and recent versions have increased computing and storage capacities to make them truly a hand-held computer. In fact, PDAs have a level of popularity that has led some educational institutions to require the purchase of a PDA (Alford & Hill, 2003). Yet the use of the PDA within education has been limited. Examples of PDA use can be found in diverse educational settings, such as engineering (see for example Battig, 2002); also traditional PK-12 education is utilizing the device. But little is being done within higher education to assist preservice teachers in developing the knowledge and skills necessary to utilize such a technological tool. Furthermore, little research has been done on the efficacy of PDA use by preservice teachers.

The focus of this research project was to engage science education preservice teachers and the faculty member supervising the preservice teachers in the integration of the PDA into their professional work. This research also explores whether the integration of PDAs into student teaching will result in science teachers being more likely to incorporate technology into their own science teaching. Specifically, we are interested in better understanding the use of the PDA in enhancing communication, reflection, and productivity of our science education interns and science education faculty.

Action Research

During the fall semester of 2004, four science education interns were provided Palm Zire PDAs. Concurrently, the university faculty member who supervised the preservice teachers' internship was also given a Palm Zire PDA. All five individuals were initially trained in the use of the PDA as a tool for data collection and personal/professional management. The following guidelines were given to all participants for using their PDA:

1. Use the PDA on a daily/weekly basis to write reflections about your internship experience. Remember to email the these reflections to the university supervisor as attachments.
2. Use the camera as another way in which to document your journey as an intern. For example, what pictures represent your thoughts, feelings, and beliefs? How can you represent your reflections with a picture? (NOTE: these do not have to be pictures of students...use your imagination and make sure you provide an explanation of the picture).
3. Explore the PDA for other applications that could improve your productivity. For example, could you use the spreadsheet to keep a grade book? Could you use it in other ways within the classroom for teaching/learning?
4. Make sure to sync your PDA daily and charge it overnight.

Method

The purpose of this research was to examine and describe the experiences of a faculty member and interns through a phenomenological study in order to better understand these experiences as they relate to the use of the PDA. Specifically, this type of study was chosen since the purpose of a phenomenological study "is to describe and interpret the experiences of participants in order to understand the 'essence' of the experience as perceived by the participants" (McMillan, 2000, p. 269). Participants were selected using a comprehensive sampling technique (McMillan, 2000) that represented all of the students registered for science internship during the fall semester of 2004. The sample also included one faculty member who was a participant observer (a member of the group not known as the researcher, McMillan, 2000). The key informants (four interns and one faculty member) provided primary sources through reflective journal writing throughout the semester. The focus of the journal writing was to answer the following questions on a weekly/semester basis:

1. How will the PDAs provided to interns enhance their ability to reflect on their teaching and effectively communicate these reflections to the science education faculty?
2. Is the PDA a useful tool that enhances interns' productivity in the classroom? If yes, how? If no, why not?
3. Will you be more likely to use the PDA, or other types of technology, in your classroom after this experience? If yes, why? If no, why not?

All data were collected at the end of the semester and coded for categories and themes in the writing. The emergent themes enabled researchers to reconstruct the participant's perceptions and experiences using PDAs in their science classrooms. All four intern participants were placed in similar science classroom settings. The schools were either high schools (grades 9-12) or middle schools (grades 6-8) in a suburban southwestern city, with a population of approximately 100,000. The school district was well funded, with a wealth of resources, including technology (e.g., computers in the classroom for teachers' and students' uses). The informants included three female science education students, Carol, Wendy, and Linda (all Caucasian), a male science education student,

Tom (Hispanic), and male science education faculty member David (Caucasian). All names were changed to ensure anonymity. Tom and Wendy both expressed an interest in and expertise with technology. Carol, Linda, and David all indicated that they were novices vis-à-vis technology use and integration.

Data Analysis

Data analysis occurred after the end of the fall 2004 semester and an inductive data analysis technique was used. This technique, unlike those used in quantitative studies, focuses on gathering data and synthesizing the data inductively to generate generalizations (McMillan, 2000). Through the establishment of patterned regularities (summarizing the data and capturing the essence of the data) each set of reflections was coded and themes emerged regarding the informants' perceptions of PDA usage. Using multiple entries over the course of a 16-week semester provided multiple data points that helped to ensure consistency in emergent topics or themes.

Findings

Several themes were prominent throughout each of the informants' reflective writings. Not only was there consistency over the course of the semester in the themes, but also consistency among the informants themselves, with a few exceptions. Not surprisingly, one major theme throughout the reflections of the interns was the idea that the PDA enhanced their organization on a daily basis. The intern informants mentioned topics such as the calendar, reminder function, and contact database as functions that assisted them in their organization. However, the other clear theme throughout the intern reflections was that the PDA did not enhance their productivity. In fact, in several cases they believed that the PDA actually hindered their productivity in the classroom.

Purpose of Technology

Three of the intern informants stated that the PDA was too cumbersome to write on effectively (note that all PDAs were equipped with portable key boards) and that it was much easier simply to use the computer that was already in the classroom for notes or reflections. Carol stated, "It was easier to write down [my] thoughts...and then type them straight into my computer at home...I was just using it because I was making myself...the PDA was not something that I needed to survive." Wendy and Linda echoed Carol's sentiment. However, Tom—an avid user of technology and described by the faculty informant as a "techie"—had a different perspective. Tom believed that individuals have to take the time to get to know the technology in order to successfully use it in the classroom. He stated, "If an individual puts in the time to figure out how this tool can be used, they will get their investment ten times fold [sic]." Tom used his PDA throughout the 16 weeks and felt that as time went on it got easier to use and allowed him to keep up with the discussions occurring in class by taking notes more effectively. Yet, even with Tom's enthusiasm his use of the PDA diminished later in the semester,

> As the semester has gone by, it has become easier to use this PDA but the only thing though is that I don't get to use it as much because I have begun to teach more often. I still keep track of the Today's Activities, as well as the Warm-up questions...but I found it easier to just print them out (notes) so that I don't have to keep turning the PDA on over and over, every few minutes.

Wendy stated, "I used my PDA to write my weekly reflections for the first two weeks of my internship. After two weeks, however, I switched to writing my reflections directly on

the computers in the classroom." For Wendy, the use of the PDA became a hindrance, a liability instead of a tool to enhance her productivity. She found it incredibly tedious and found that the screen was hard for her to read. (She indicated at that time that she was considered blind without her glasses.) Others indicated that not only was it a distraction for them—focusing on the PDA, writing notes and not paying attention to the class—it was also a distraction for the students.

Productivity

Overall, the interns did not report that the PDA enhanced their ability to reflect, and it may have impeded the process as a result of the feeling that they had to use the PDA rather than use more "comfortable means of writing." Most believed that it did not enhance their productivity. Tom was the only one who wrote about the way in which the PDA helped him in the classroom, although in the end, he found its use to be cumbersome. An important theme emerged at this point. Those informants who reported being more comfortable in using technology in the beginning were more likely to continue to use and "test" the technology as a tool in their daily work. However, in all cases knowledge and comfort with the technology did not impact the informants' perceptions of the use of this particular technological tool.

Future Use of Technology

As important as the emergent themes highlighted were, the interns' perceptions of future use of technology in teaching science was a central concern. Without exception all of the informants indicated that they would be likely or more likely to use technology in teaching science in future classrooms based on their current experiences. Carol stated, "After this experience I will be much more likely to incorporate technology into my classroom procedures." Wendy indicated that electronic probes would be key for her future teaching. She stated, "I am far more likely to use the Texas Instruments (TI) line of Calculator-Based Laboratories (CBLs) than anything else....Students are often expected to own TI graphing calculators for math anyway." Others indicated that computers, probes, and e-Instruction tools would likely be incorporated into their classrooms. The key theme emerging at this point centers on the participants' perception of the readily identifiable purposes for technology use and identifying the technology that is most efficient in tackling an issue, problem, or task. In this study, the intern informants did not think that the PDA was the most efficient and effective tool for the task/problem at hand and came to understand that this utilization objective should drive technology selection.

For David, the faculty informant, the journey with the PDA turned out to be different in many ways. David came to this study self-described as a hesitant and cautious technology user. He also described himself as a novice, although had been using computer technology in his professional work for many years. David stated, "The PDA was quite unfamiliar to me and I was not sure I would be successful using it during my first round of intern observations...I took a laptop to the school as a back up." David's purpose for the PDA was to have a tool to record observations of the interns' teaching. He typically carried a portable computer to school sites and typed observation notes during the interns' classes. David found that the compact size and convenient keyboard was an asset. As the semester progressed, David not only recorded observations using the PDA and keyboard, but also engaged in reflective discussions with interns regarding the lessons he observed. On one occasion, David suggested to an intern that he wished he had a tape recorder to tape the conversation. The intern, Tom, indicated that the PDA had a recording function, one of the many uses, according to David, he was yet to discover.

David's role as participant observer was to use the PDA and also engage the interns in discussions regarding their use of the PDA. David found that the two interns who were more "tech savvy" were not only using the PDAs more frequently, but were more positive regarding the usage. The other two interns had indicated that they were using the PDAs sparingly...for now. However, based on the reflections of the interns, at least one gave up on the PDA after only 2 weeks of use. Although the others continued to use the PDAs throughout the semester, their uses and opinions of the PDA varied. As the semester came to a close, David indicated that the PDA was a functional tool that was portable and compact. His only complaint focused on remembering how to transfer data from the PDA to his portable computer.

Although this was a small-scale study involving five individuals, the results and subsequent themes provided us with key insights for future use of technology in science teaching. Not surprising, prior knowledge or use of technology seems to be important with regard to the way in which individuals approach the use and integration of technology in their professional lives. This does not mean that comfort with technology assures technology usage, rather it should imply that individuals who are more comfortable or knowledgeable with technology (globally speaking) are more likely to attempt integration. Both of the interns and the faculty member who were reluctant and novice technology users started out slowly using the PDA. All three had varying success with the technology and at least one quit using the PDA after only 2 weeks. The other two informants (both student interns) had more knowledge and a higher comfort level with technology to begin with, but in a similar fashion limited the integration of the PDA. For all informants, integration came down to a single common theme: purpose of technology.

Throughout the semester, the interns and the faculty member directly or indirectly referred to the specific purpose of the technology or the purpose of technology, in general, for teaching science. Not unlike Kruger (2000), we found that a clear and effective purpose for technology that matched specified outcomes was key for all of our informants. From our research, we also concluded that the simplest, most efficient technology for a particular task was essential. In the case of the PDA, writing reflections and transferring them was less efficient then either writing the reflections by hand and transferring to a computer or composing directly on a computer and transferring to an individual's storage device. The PDA did not represent the simplest and most efficient technology available for the task. This is true, even though all informants commented on the PDA's portability, convenience, and potential for integration.

One additional and essential finding is the perception that teachers *need* to integrate technology. This emphasis on the use of technology, like other past "innovations" in education (i.e., cooperative learning), puts pressure on teachers to integrate or use the innovation to meet an expectation rather than having a definite purpose for its use. Our informants described this phenomenon different ways, but Carol stated it best when she said she was "making herself" use the technology because of an external expectation rather than using the technology for an expressed purpose.

Conclusions/Implications

As indicated previously, this was a small-scale study involving only five individuals. However, several implications from this study are pertinent and corroborate other research done in the area of technology and technology integrations. Prior knowledge does play a key role in how the participants used the technology in this study. It would also appear that beliefs about technology use and its role as it relates to the teaching of science is also key. Consider that Mumtaz (2000) found,

> Despite essential technical support provided...the teacher factors that involved beliefs about the way the subject should be taught and skills associated with competence in managing classroom activities and computer-handling technical skills were the most influential in teachers' use of computers. (p. 337)

In the current study, the belief about the purpose of the technology played a central role regarding the success of integration. Some informants in the current study indicated that the technology "interfered" with their teaching rather than enhancing it. This is not unlike Cantrell and Knudson (2006), who report a similar result in their study, in which participants believed that technology interfered with doing science inquiry. The implications are clear; replacing one instructional media with another does not automatically improve learning (Thornburg, 1999). Thornburg went on to say that two ideas are important to address when considering technology as a media, or tool, to enhance learning.

1. How you use technology in education is more important than if you use it at all.
2. Unless our thinking about education is transformed along with our continuing expansion of telemetric technology into the classrooms, our technology investment will fail to live up to its potential. (p.1)

We agree with Thornburg and believe that we need to do more to educate prospective science teachers about technology and the ways in which it can be effectively used in the classroom (Pedersen & Yerrick, 2000). However, we must make sure that science teachers are engaged in a process of understanding (a) the ways in which technology enhances teacher's practice and (b) the method by which they must match the technology and practice to specific purposes and learning outcomes.

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