BENEFITS OF MEDIA USE IN PRIMARY TO POST-SECONDARY SCHOOL SCIENCE CLASSROOMS

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ABSTRACT

Society is moving more and more into the digital realm in all aspects of daily life. People of all ages are using technology to make their lives easier and more enjoyable. Children are learning how to operate the family computer or the television before they even learn to walk or talk. This technological movement is starting to carry over into how humans learn information; books are no longer adequate supplements to learning in the classroom. In the field of science, there already exists a standing problem: student misconceptions of scientific concepts due in part to improper instruction. With even less learning being done from books, this could greatly increase the amount of confusion in higher education. By consulting current research exploring the use of technology in the classroom as well as current information on how students learn, this article will show that the use of tablet technology, as well as other media, in teaching can increase the amount of information absorbed and retained by students.

INTRODUCTION

Today's society is becoming more and more dependent on technology. It is used as a primary means of communication; information gathering; entertainment; buying and selling of goods and services; and soon, if not already, education. Children are exposed to so much technology that they are learning to operate the family television before they even learn to walk or speak. Rideout found that 74% of children 6 months to 6 years old know how to turn on the television by themselves; it was also found that 58% can operate the remote control and 46% can put in a DVD by themselves [2006]. Researchers did find that only 19% of children can turn on a computer while 28% can use the computer by themselves. However, in a recent study by Common Sense Media, researchers found that an estimated 52% of children between 0 and 8 years old have access to some sort of mobile device in their home; among these children's parents, 29% have downloaded applications specifically for the child [2011]. In addition to mobile devices, the study reported 53% of 2 to 4-year-olds and 90% of all 5 to 8-year-olds have used a computer and most do so frequently; this is a direct result of 72% of all 0 to 8-year-olds having access to a computer at home. Not only are these children accessing games and applications via media, but the study found that children under 2 are spending more time watching television than reading. They found that on average, children from age 0 to 1 are spending 53 minutes a day watching television or videos while they spend only 23 minutes a day reading or being read to; this could be partly attributed to the rise in the number of televisions in these children's bedrooms from 19% in 2005 to 29% more recently. Even more indicative of the influence of media is the fact that 16% of 0 to 8-year-olds use more than one technology at the same time and 79% of 5 to 8-year-olds watch television while doing homework. However, the increase in media use over the past few years is not only present in younger children but in teenagers as well.

Madden found that 78% of teenagers own a cell phone, with 37% of all teens owning a smart phone, which has already increased from the mere 23% in 2011 [2013]. In addition, 23% of teenagers own their own tablet computers and 93% of them have access to a computer at home. Another study found that 62% of teenagers get current news topics on the internet [Leinhart, 2010]. Researchers also found that 63% of teenagers go online everyday with 36% accessing the internet several times a day [Leinhart, 2010]. In a 2010 study, The Henry J. Kaiser Foundation found that children from age 8 to 18 were using different types of media 10 hours and 45 minutes on average per day; this is nearly a 2 hour increase from 2004 [2013]. Also, The Henry J. Kaiser Foundation found that 29% of media use time was spent multi-tasking with a variety of media but with most time spent listening to music, using a computer and watching television [2013]. The trend of increasing technology and media use in grade school aged children also is true for college students.

In a study by Leinhart, researchers found that 93% of adults between 18 and 29 years old own a cell phone; this age group makes up the bulk of what are typically considered “traditional college students” [2010]. Researchers also found that 66% of 18 to 29-year-old adults own a laptop and 53% of them own a desktop. After surveying students in 11 libraries at 10 colleges, Head found that 58% owned a laptop that they were using for work in the library while only 35% were using desktop computers made available to them [2011]. In the survey, researchers found that 81% of students were checking social media or email messages while there with 73% preparing for a class and 62% studying for an exam; oddly enough, only 36% were in the library looking for research materials. Head also found that 60% of students were multi-tasking by checking messages and working on assignments while 52% were checking for messages and studying for exams [2011]. However, as impressive as these data seem, the fact that only 36% of students were using research materials in the library may be troubling.

A study by Iyengar found a 7% decrease in the amount of adults over the age of 18 who read for pleasure in the ten years from 1992 to 2002 [2007]. There was a 5% increase in 13-year-olds who reported not reading at all for fun and a 5% decrease in those who said they read every day; this trend was shown to be typical of other teenage age groups as well. 65% of college students had reported reading less than an hour per week or not at all for pleasure. While the amount of time spent reading for pleasure may seem trivial, it seems to correlate directly to a decline in reading levels and test scores. Reading scores for 17-year-olds have declined slowly since 1992 as the amount of time reading for pleasure has dropped, while those for 9-year-olds have steadily increased with the time spent reading for fun remaining constant. As for high school seniors, Iyengar reported a 5% drop in the amount of students reading at their proficiency from 1992 to 2005 [2007]. These declines have large repercussions later in life for students. Employers have reported that 72% of high school graduates they hire aren't at the appropriate writing level and 38% do not meet the correct reading proficiency. In general, those with higher reading and writing proficiency are more likely to be successful while those who have lower proficiencies will have a more difficult time advancing in their careers.

With the amount of students reading at an appropriate level for their age being in decline and the number of students using media of many types being on the rise, the necessity for altering the way children are educated becomes more apparent. In order to keep up with ever changing technology, educators and parents must consider adapting and introduce media at an earlier age as well as increase its use in molding the minds of children. Many studies have been conducted already that provide evidence and suggestions on how this can be achieved in this fast-paced world.

TECHNOLOGY USE IN PRIMARY CLASSROOMS

In 2011 in Sydney, Australia, a study was done to look at iPad use in primary schools. The purpose of the study was to provide the schools with information regarding purchasing and using the iPads in classrooms as well as providing assistance to teachers. The study was conducted in three different schools with five teachers, around 90 students and 75 iPads. The iPads were purchased by the school system, which then partnered with the New South Wales (NSW) Curriculum Learning and Innovation Centre (CLIC) to determine what the study should focus on. In order to evaluate the specific areas of focus, researchers used a combination of student and teacher surveys; parent, student, teacher and principal interviews; and teacher and student blogs, as well as observing lessons using the iPads, looking through samples of student work and looking at applications used. After collecting their data, the information was combined and common themes were noted. Researchers found one of the bigger complaints about the project was the increased demand on the teachers' part when the iPad was introduced to the classroom. Teachers had to spend more time finding appropriate applications as well as making sure they fit the NSW curriculum before even installing them on the iPads for student use. The study found that based on comparison of the applications to the NSW curriculum, only 43% were relevant and considered "instructive, games-based apps". Teachers also said that they believed "content-creation" applications were more beneficial to learning than "instructive, drill-and-practice game" applications; this was because while the instructive applications caused students to recall facts and memorize information such as multiplication tables, the content-creation applications required more thought and forced students to display more understanding in topics presented. In general, researchers concluded that the study showed that there is a substantial amount of evidence supporting the idea that iPads increase student engagement and cause them to work together more both in person and online. These findings led to an overall better learning experience for students. Some of the teachers speculated that these improvements are due to how easy the applications were to use, the ability of the teacher to focus on individual learning needs, and the fact the openness of the applications allowed students to learn and discover independently [Goodwin, 2012].

In 2010, a study was conducted in a university-based early childhood center in the northeastern United States. The purpose of this study was to evaluate if stylus-interfaced technology was a possibility for use in early education and if it complies with the current technology standards for early education. Researchers studied three preschool classrooms with 41 children total ranging from 3 to 6 years old. From a pre-survey, researchers determined that on average the children spent about 22 minutes a day playing games or using educational software at home; it was also reported that 73% of the children used the computer they had at home and 29% had used touchscreen and stylus technology before. The data was collected over a period of six weeks and the children were limited to only using stylus technology. The study took place as an alternative to an assignment where the children were being asked to draw a self portrait for the second time. Typically as part of the assessment of the child's development, they were asked to draw self portraits three times during the school year. Each of the children was asked to draw a self-portrait using a tablet with Microsoft Word. The children went through three different sessions. During the first session, researchers gave the children basic instructions on how to use the tablet and the basic features available to draw on it; they were then able to practice using these tools. In the second session, the children were asked to actually draw their self-portrait; they had access to a mirror for reference. After completing their portrait, the children were asked to come back to answer questions about using the tablet and what their preference was over paper and pencil drawings. The teachers also were interviewed about the children's interest in the tablet technology and differences and evaluation of the portraits created with the tablets. The study reported that teachers rated 66% of the self-portraits as typical but 20% exceeded their expectations. From the children's interviews, it was reported that 64% preferred using the tablet. The study concluded that as the children grew accustomed to the tablets, they became more independent and were more likely to try different things and be more creative [Couse, 2010].

A study in an elementary and middle charter school in the northeastern United States explored the possibility of game creation being a tool for learning. The purpose of the study was to learn about the processes children undergo as well as the problems they encounter while designing a game in a science classroom. The class being studied consisted of 10 fifth-graders. The students were asked to choose an environmental problem out of their book to research and then design a game in order to teach it to second-graders using a program known as "Scratch". All of the students had previous experience with "Scratch". The students were each given a laptop computer to design their games but were free to share ideas with their fellow classmates. Two science teachers and a technology teacher were present when the students worked on the project. The science teachers were primarily responsible for managing the classroom primarily because they had no previous experience with "Scratch", while the technology teacher helped answer questions about game design. At the end of the study, researchers found that each of the students had created an environmental science game that displayed real-world scenarios with a few unrealistic features. Though there was no direct measurement of the amount of knowledge about science obtained by the students as they created their games, the process each student underwent was very telling of the fact that learning was still going on. Many times while working on a certain aspect of their games, students were asked by researchers what certain things represented and why they were there. When the answer was unclear, the students researched it and the researchers observed a change in their game. The children also modified things in their game based on testing and playing games other students had created. The researchers speculated that game programming was a potentially constructive way to foster learning in children; for the students not only taught themselves new scientific information in order to teach others but also learned different computer programming skills by observing and mimicking those around them [Baytak, 2011].

In a study in Montreal, Quebec, researchers explored how to better use computers for tutoring. The subjects in the study were eight 4 to 5 year-old children at a local childcare center. The children were required to be at the center every day for two weeks in order to participate in the study. The researchers collected data by asking the parents to complete a survey that included information about their child's computer use, recording tutoring sessions, and observing tutoring sessions. The software used in the tutoring sessions was designed for twenty-minute sessions. It focused on development of learning the alphabet, phonetics, fluency, comprehension, and writing. The program also contained tools for the tutor's use including planning and means of communication between the teacher and the tutor. During the sessions, the tutors used activities such as letter sounding, word-level blending, auditory blending, auditory segmenting, and spelling in order to achieve the objectives of phonetic awareness, letter sounds, and sound blending, which were decided by the researchers. The tutors and observers were trained to use the software prior to participating in the study. The tutors were given a laptop computer and a paper manual in order to conduct the sessions. The children worked with the same tutor for all ten days they were in the program. The first session involved an assessment of the child's skill level; the other nine sessions were individualized to fit each child's needs. At the end of each session the children received a reward built into the software program as well as a tangible reward from the center. The survey results showed that most children were read to several times a week and though all of the children had access to a computer at home, only three used it frequently. The data showed that the children had no reservations about getting acclimated to the software. The researchers also observed that the attitude of the tutor greatly impacted the experiences the children had. For instance, if the tutor was in a poor mood, the child focused on the computer program; whereas, when the tutor was lively, the child was more interested in them. Observations showed that the tutors also greatly impacted the learning experience by offering feedback and motivation to the children as they worked through the program. The researchers concluded that the software involved in this study is very useful as a tool but nothing more; the tutor's instruction and support still provided the primary means for learning for the children [Schmid, 2008].

A study attempting to understand how children's attitudes towards working together changed while collaborating on a software-writing project was completed in 2006. This study was done in three classes in a mid-size town in the midwestern United States: one class contained 20 kindergarten students, one was comprised of 21 kindergarten and first grade students, and the final class had 23 first-graders. Twelve pairs of children were selected from each class. All of the children were paired and asked to participate in a writing activity requiring them to collaborate with the other pairs of children involved in the study. The rest of the study occurred over three semesters with a different phase each semester. During the first phase, the researchers observed each class and helped the children learn Kid Pix Studio Deluxe writing software. Near the end of first semester, the pairs were asked to write their first story and were videotaped while doing so. In the second phase, the children were asked to write three stories and their interactions were recorded again. During the final phase, interviews were collected with the teachers. Researchers observed that over the course of the study, children changed from being independent to being more collaborative; the children also shifted the role of leader between each other. Less competent children also were observed doing important tasks more often as the study progressed, which researchers speculated was an indication that the more competent child in the pair offered assistance to the less competent one causing them to grow and learn [Chung, 2006].

A study at the National Institute of Education at Nanyang Technological University in Singapore observed the use of a stylus-driven painting and drawing program on a tablet computer by young children. The purposes of the study were to gain an understanding of how children develop symbol and sign formation skills through painting and drawing and to determine whether doing this using technology had an impact. The subjects of the study were 12 children between the ages of 2 and 11 who had no previous interactions with computers or tablets. Researchers used a program called “Artrage” that allowed children to draw pictures on a tablet. In each session, the children were brought in, introduced to the tablet, and were then allowed to spend an hour with the tablet to draw whatever they wanted. During the first sessions, parents accompanied the child; during later sessions, siblings or sometimes just the investigators accompanied the child. All of these sessions were videotaped for analysis. One of the main surprising things that researchers observed was that very young children were just as eager to explore the array of colors as the older children; the researchers had previously thought that the vast spectrum of colors available in the program would overwhelm two and three year-olds. The researchers observed that in addition to the variety of colors used, all of the children were able to adjust the lightness and darkness of the colors as well as use a variety of shapes; they even observed children using Chinese letters in their drawings. Due to the success the children were having with the tablet use, the researchers decided to introduce them to a simple game design program known as “Scratch”. This program allowed the children to transfer the skills they had acquired from drawing on the tablet to another type of technology, which they used to animate their pictures. The authors did not go into much detail of the results of the programming portion of the study other than to say that children seemed to be able to retain skills previously acquired to achieve success with the programming software. During the children’s interactions with the tablet computer, the researchers observed that the aid of the adult present and the functionality and usability of the tablet had a huge impact on the success of the sessions. They found that after a few sessions all of the students were able to open the program and retrieve saved files to continue working on their drawings. The study concluded this electronic paint program could be a valuable tool in teaching children how to paint. In addition, they speculated that this technology could clarify the topics of color, hue, and tone, which the researchers felt were difficult to teach to children using traditional methods [Matthews, 2007].

Researchers in Singapore conducted a study where they designed a series of lessons using a drawing program known as “Group Scribbles”. The purpose of the study was to observe the use of Group Scribbles to improve collaboration between fifth grade science students. The Group Scribbles program was made up of an area where students could design their own work as well as one where they could share it and compare it to other students; the software also allowed them to post pictures and comments anonymously. The software was run on a tablet computer and a stylus was used to draw as well as alter different features such as the color of the ink and thickness of the pen. The teacher also had the ability to interact with each of the student's sheets. The subjects of the study were 40 students in a fifth grade science classroom. The students were taught a lesson about the topic of "dispersal of fruits and seeds"; during the lesson, they were supposed to learn how seeds were dispersed. The class was divided into 10 groups of four students each. Using the Group Scribbles software, students were asked to explain their ideas using words or pictures on a private board, share their ideas with the other students in their group on a group board, look at boards created by other groups, collect comments from the other groups on their own board, and finally present their ideas to the whole class verbally. 38 out of the 40 students presented their ideas on the ten group boards. The researchers found that the facilitation of the activity allowed each student to present ideas equally without one student monopolizing the discussion with their own ideas. The fact that students could post anonymously allowed them to post more freely without fear of being embarrassed. The researchers concluded that the program was an effective tool in fostering interaction and supporting collaboration [Chen, 2011].

TECHNOLOGY USE IN SECONDARY CLASSROOMS

During the 2007-2008 school year, a study was conducted in a suburban New York middle school collaborated with the University of Buffalo to design a curriculum and lesson plans to integrate computers into the science classrooms. The main purposes of the study were to evaluate the affect of combining inquiry based teaching with technology on students' learning, find out what technologies were deemed helpful in learning science by students, and how students felt technology could improve science teaching. The study primarily focused on two science teachers in particular; the teachers were given fifteen MacBook computers as well as probeware and software for use in their earth science and physical science classes. The teachers used scores from previous standardized tests to guide their development of the lessons, labs and student projects. These activities were relevant to real world topics. They also created specific exams and rubrics to determine student knowledge of the topics presented. The teachers used the MacBook computers to make podcasts, photo books, and slideshow presentations, as well. Probeware also was used because it helped students gather data quickly but required little setup so that students could collect and analyze data in the same day. The ability to collect actual data allowed for students to have a more solid understanding of concepts being discussed in the classroom; it also forced students to focus on data analysis and critical thinking. In addition to collecting test scores to assess the study, researchers collected surveys of student learning styles, technology use at home and observation of teaching styles. The teachers also were interviewed about their perceptions of the project. The earth science class had been previously considered a difficult course; however, enrollment increased 42% during the year the study was conducted. The introduction of the MacBooks and other technologies increased the amount of time the students spent in the classroom. 100% of students who took exams scored between 65 and 100% and no students dropped the class. Researchers also found that students in the physical science class had made massive improvements from previous years. The number of students achieving the highest scores of 3 or 4 on the New York State Grade 8 Science assessment increased from 91% to 94% with the addition of technology in the classroom; the number of students receiving a 4 on this assessment alone increased from 41% to 58%. The survey of learning styles found that only 15% of students considered themselves “logical-mathematical” or “verbal-linguistic” learners. Furthermore, 40% of students considered themselves visual learners. This means that a vast majority of students were not being reached by traditional teaching methods such as lectures, notes, or textbooks. After the study, a large number of students surveyed said they felt their teachers were "[using] methods that matched my learning style" and over 80% were satisfied with the use of technology the teachers used in their lessons. The researchers infer that this could mean that more students were being reached because the teaching strategies were more catered to their learning styles [Yerrick, 2010].

A study at the Educational Technology Center in Israel explored the possibility of using simulated laboratory experiments to educate students. The goal of the study was to present a series of support programs and observe and examine their effects on academic achievement. 473 seventh grade students from 16 classes in 33 schools were randomly assigned to 5 groups. The Educational Technology Center has a computerized environment that can simulate laboratory experiments; there are 42 out of 60 different problems students can solve that directly apply to the science curriculum. The students all used the same textbook and were given appropriate worksheets based on the group they were in. Each group was assigned a specific program that offered a different level of support while working on the worksheets; these programs offered a different number of what the researchers referred to as "support components". These components were called structural, reflection, subject matter, and enrichment. The structural component in general guided the student to the correct answer without much thought. The reflection component caused students to scrutinize possible solutions as well as define reasons for error. The subject-matter component simply gave concepts relative to the problem and provided specific instructions. Finally, the enrichment component caused the students to relate the problem they were trying to solve with other relevant subjects. The programs made up of these components were called Teacher A, Teacher B, and Teacher C; the final two programs were an enrichment program only comprised of the enrichment concept and a control program where students received no support whatsoever. Teacher A, Teacher B, and Teacher C all contained the structure component and the enrichment component; Teacher B and Teacher C both had the reflection component. In addition to these, Teacher B had a subject matter component where specific instructions and text explaining what was going on were presented, while Teacher A had a subject matter component where only specific instructions were given. The students were asked to perform the experiments, find missing data and suggest a reasonable answer to a problem based on their findings while filling out a worksheet. An assessment was administered at regular intervals during their time spent working on the study. The purpose of the assessment was to test retention and understanding of the subjects presented in the simulations. Researchers found that students in groups using the Teacher B and Teacher C programs had a higher achievement than in Teacher A; they speculate that this means that the subject-matter component was surprisingly insignificant and the structure and reflection components have a large affect on achievement. They also predicted, based on higher achievement correlating to the addition of the reflection component, that the reflection component forces more responsibility for learning information on the student than on the instructor which builds a better foundation for knowledge and leads to those higher achievements [Fund, 2007].

A study at Tel-Aviv University's Science and Technology Education Center looked at the effect of using a virtual model of the Solar System to teach high school students about it. The purpose of the study was to be able to analyze the development of the high school students' understanding of astronomy by interacting with the virtual Solar System. The virtual Solar System has a Free-Mode, Sun-in-Site mode, planetary mode, and geocentric mode, which users can choose from in order to observe it. Users also have the ability to adjust rotation and revolution rates of the planets. Nine 10th grade students acted as the subjects for the study; they were given a pre-test to assess preconceptions and existing knowledge. The study occurred in a lab in individual sessions lasting for a couple hours where each session was repeated with different assignments four times. After becoming acclimated with the program, the students were given two assignments consisting of a series of questions where they were asked to observe and answer questions about something occurring in the Solar System. The students were not given any help but rather were required to explore and experiment on their own to discover the answer. During these sessions, the students also were recorded so the researchers could observe their learning in real time. The researchers concluded that the virtual Solar System was a reasonable tool that could be used in helping students learn about the Solar System, especially those who are visual learners. However, there also were problems that arose that would need to be resolved: they found that based on certain observations during the sessions, students were developing misconceptions regarding certain phenomena that were occurring. The researchers feel that this is most likely due to the lack of assistance when working with the simulation and that guided use of the virtual Solar System would yield better results [Gazit, 2005].

In Kenya, there was a study conducted that examined the use of a computer simulation and its effects on biology education. The purpose of the study was to explore the effectiveness of a computer simulation in improving the learning outcomes of students of cell theory. The subjects of the study were 102 students from 3 secondary schools in Kenya. The students were split into three groups: two of the groups received a pre-test and the third did not. The group that didn't receive the pre-test as well as only one that did then used the simulation before receiving a post-test; all three groups received the post-test. The simulation was made up of images that illustrated the topics of interphase, prophase, metaphase, anaphase, and telophase, which also were explained in words. These topics are the main stages of cell division and are part of the standards for schools in Kenya. The students were given brief instruction on the task they were being asked to complete before being divided into their groups. They were allowed to work on the program for a set amount of time and then were interviewed at the end so that researchers could collect their views of the program. The researchers found that there was a significant difference in the post-test scores of students who had used the simulation and those that didn't. They concluded that based on these results, the simulation has a large affect on how students learn the information presented about the cell theory and speculated that this claim could carry over into other computer simulations as well [Kiboss, 2004].

A study in the northern part of Israel focused on the use of a computerized simulation as a supplement to the traditional curriculum in middle school science classrooms. The objective of the study was to analyze the effect of computer simulation on how much seventh-graders understood kinetic molecular theory. The researchers examined three classrooms in two middle schools consisting of 133 seventh grade students total; the classes were randomly split into control classes and experimental classes. The students were taught a series of chapters in the book, given a pre-test, taught another chapter of the book, and then given a post-test; after the experiment, a group of five students each from the experimental and control group were selected to be interviewed. During the lessons after the pre-test, the experimental group used the computer simulation entitled "A Journey to the World of Particles" in addition to the regular instruction. The simulation allowed students to observe particles under different conditions of varying pressure, volume, and temperature and make predictions about what will happen when certain conditions change. The experimental students also were exposed to a second computer simulation developed by the researchers, which explained the differences between particles and their usual representation in terms of size, dimensions, and other characteristics in order to dispel common misconceptions they might have obtained from the other simulation. The researchers found that on average the experimental group improved their test scores by 29 points; whereas, the control group only improved theirs by 12. The students in the experimental group scored higher overall than those in the control group. The researchers concluded that in general the simulation helped to improve students' understanding of kinetic molecular theory. In addition, they observed that more of the students from the control group had misconceptions about particle movement and speculated that this may be due to the lack of interaction with the simulation. They also concluded that simulations should not be used as a stand-alone method of teaching but rather as a supplement to other methods of instruction [Stern, 2008].

In a study in a middle school in a mid-size midwestern town, researchers examined the effect of technology on influencing inquiry in sixth grade science students. The subjects of the study were 42 sixth-graders who were part of two sections of a class taught by a single teacher. In order to study the classes, researchers simply observed the teacher teaching as she normally did and then interviewed her and her students; ten students total were selected randomly for interviews. All of the classes were videotaped and random groups of students were recorded by microphone so the researchers could observe their verbal reactions. Researchers observed the teacher lecturing over two science units; she supplemented instruction with simulations and Internet searches. The researchers also observed the teacher assigning I-books to students to be used as a digital form of the textbook. The researchers concluded based on the poor response towards the I-books in terms of increased inquiry that the teacher is still highly instrumental in the success of technology in enhancing learning. In fact, it was discovered that in this particular classroom, there was more inquiry occurring in the absence of computers altogether. It was concluded that the role of technology in the classroom is primarily dictated by the teacher's attitude toward technology. If the teacher is comfortable with it and uses it creatively, it can be far more beneficial than if it is simply used in the place of another medium [Waight, 2007].

TECHNOLOGY USE IN POST-SECONDARY CLASSROOMS

At a large urban research university in 2004 and 2005, a study was conducted to look at the use of a virtual reality component for an undergraduate course. The goal of the study was to provide an interactive learning experience through a virtual reality environment. The course was called HDCS 1300 Family Ecosystems and was designed to look at social issues from multiple disciplines like psychology, anthropology, and economics, among others. There were 46 widely diverse students enrolled in the course. The virtual reality module was only one portion of the course requirements. Researchers used Adobe Atmosphere to create a virtual campus for students to access. When the students accessed the virtual environment, they selected an avatar and were free to move around the campus and explore buildings. One of the buildings contained a module that students were asked to complete with a variety of assignments to complete. The students were asked to complete these assignments by a certain time but were allowed to do them in any order they chose. In order to evaluate the success of the virtual environment, a focus group was created. The response was generally positive but because it was a pilot project, there were issues that needed to be worked out; for instance, it was recommended that training be offered for the students before using the virtual environment for the first time so that they could experience it fully. The researchers concluded that the virtual environment can be an effective tool for an interactive learning experience; however, there may be too many challenges to overcome to make it a feasible option in the near future [Steward, 2010].

Between 2004 and 2009 at the University of Southern Queensland in Australia, a study was conducted to examine the use of tablet computers and virtual classroom software for various math classes. This study was inspired by the fact that 80% of the students enrolled in the university were studying by distance or online education. The tablets and software were used to record and distribute lectures, record tutors for later distribution, record video of hard to understand topics to be viewed later, conduct one-on-one meetings between teachers and students at a distance, and host group meetings with students all over Australia. There were three main modifications made to the traditional method of teaching these courses: the lecture, the tutoring sessions, and one-on-one meetings; and students were asked to complete surveys in regards to their feelings on each of the modifications. The primary mode of teaching in the math lectures had traditionally been writing on a whiteboard or projector. During this portion of the study, researchers altered the lectures in a Foundation Mathematics class and an Algebra and Calculus class. A tablet was used to record lectures in the Foundation Mathematics class. In both classes, the instructor used the tablet to write out solutions to problems while at the same time explaining them; the software not only captured the process of solving the problems but also recorded the audio explanation. After this particular segment, the researchers recorded a full set of lectures for a class. One of the surprising findings was that there was no decrease in student attendance on-campus even though all students had access to the lectures online. In addition to lectures, students had the option to attend tutoring sessions; typically students could attend these tutoring sessions either face-to-face or online. The online tutoring sessions were offered through Windows Live Messenger. The university also tried using Elluminate Live! to do the online tutoring sessions. The students seemed to respond a little better because they were able to receive immediate responses, including audio, when they needed help; this software also contained a shared whiteboard that allowed everyone in the session to interact with it. In an attempt to further improve this experience, researchers implemented the use of tablets in the tutoring sessions. The tablet was wirelessly connected to a projector so that the tutor could have students solve problems without leaving their seat but the other students could still see the solution. In order to improve the one-on-one consultations, the tablet was used as an alternative to the traditional phone or email method. During face-to-face sessions, instructors could explain the solutions to a problem using the tablet; in addition to this, however, the instructor could just as easily record the process of solving the problem along with audio and email it to the student, especially if the meeting is from a distance. Some of the major advantages given for using tablets in lectures were that the lectures were easier to understand, they allowed the instructor to respond to students' questions, and they could be recorded to be revisited later. Some of the disadvantages noted were that handwriting can still be an issue, complex solutions can become difficult to follow, and that the technology didn't always function correctly. Some of the major advantages of using the tablet in the tutoring sessions were determined to be that it was easier to see how people are solving problems without being intimidating, it helped to see where mistakes have been made, and the sessions could be recorded and viewed later. The disadvantages were that it was still difficult to find time for everyone to meet even online, some students were not acclimated to the technology, and sessions became difficult when there was no clear plan for using the tablet. In the one-on-one sessions, the major advantage found was that the solutions to difficult problems could be recorded for use by more than one student and revisited at a later time. The disadvantage is that recording the solution with another student presented a problem with possibly embarrassing the student and with confidentiality. The researchers concluded that even with a few setbacks, these processes are beneficial ways to use tablets in order to improve instruction in math classes [Galligan, 2010].

In 2007 at Open University, a study was done exploring the use of tablets for tutors to mark assignments for students. The purpose of the study was to test the pilot program which would not only allow for a quicker turnaround on assignments but also allow for more valuable feedback for students. Most of the courses at Open University required assignments to be submitted to a tutor to be graded and returned. The tutors were dispersed throughout the country and were each responsible for around 25 students. Prior to 2006, the method for submitting assignments to the tutors had been by mail, which caused issues in that it took time for tutors to receive the assignments, submit graded assignments to the university to be recorded, and for the students to finally receive feedback. In 2006, the university implemented an electronic system to submit assignments in order to produce faster responses and reduce headaches. This method was not required but was highly recommended to be used whenever possible. With this system, students were able to submit their assignments online; and the tutor could download them and grade them before uploading them again. This obviously provided a faster turnaround; however, a major disadvantage especially for those tutoring physics and math courses was that typically the tutors had limited tools in order to make notes and write equations on the assignments. Thus, the feedback to the students was sub par. In this study, researchers provided the 19 tutors of a physics course who chose to participate with a tablet computer, which had software installed that would allow them to make handwritten notes on assignments. The tutors used PDF Annotator, Microsoft Word, and Windows Journal to annotate the assignments depending on what format they were submitted in. At the end of the class, the tutors were asked to take a survey in order to give feedback on the project. The results of the survey showed that even though students were not required to submit assignments electronically, the number submitted in this way had increased to 40% by the end of the project. The tutors found that it was as easy to make notes on the tablet as on the written assignments, easier to correct comments if they found they were mistaken after writing something down, and easier to keep multiple page assignments organized; they also found that the turnaround time was faster and the electronic assignments were easier to submit than the paper ones. Some of the disadvantages discovered were that converting files to a usable format sometimes became a hassle, comparing papers to ensure consistency was difficult, and students waited until the last minute to submit assignments because they did not have to take the postal service into consideration which caused more work at one time for the tutors. The tutors also reported that the students had commented positively on the quick turnaround time, increased time to complete assignments because of not having to consider the mail, and clarity of comments written on their assignments when they were returned. The researchers concluded that with all of the positive feedback, the use of tablets for correcting assignments would be a viable option; however, the cost may prevent widespread use [Freake, 2008]

In 2006 at the University of Queensland, researchers organized a case study to examine the use of tablet technology to supplement their current curriculum. The purpose of the study was to design a more effective way to present lectures to math students. The researchers used PDF workbooks on tablets in order to teach three courses over three consecutive semesters in place of the paper workbooks that had been previously used; the three courses were Calculus and Linear Algebra I (course 1), Calculus and Linear Algebra II (course 2), and Discrete Mathematics (course 3). The courses had 320, 600, and 120 students enrolled, respectively. Courses 1 and 2 used a graphics tablet while a tablet computer was used in course 3. All of course 1 was taught by one of the researchers; the researchers taught part of courses 2 and 3, but other instructors who used overhead slides to teach taught the other parts. The workbooks were posted in PDF format so that students could download them; these workbooks were used during class and allowed the researchers and students to mark notes or fill in information in the document using the tablet. At the end of each semester, the students were asked to fill out a survey. The researchers found that 85% of students said they preferred filling in the workbooks to having a complete one given to them and 89% said they thought it helped them to understand the material by writing it down. About 92% of the students said they liked having an electronic form of the lecture notes available online and 46% responded that they never went to the lectures because the material had been posted online. In general, the researchers found that students enjoyed using the workbooks on the tablets because they had the information as well as space to write notes all in one place. They concluded that tablet technology can be very useful in the classroom, but its success was dependent on the ability of the instructor to use the device as well as a lack of technical issues [Loch, 2006].

A study at Fort Hays State University in Kansas examined how effective DyKnow software was in teaching an undergraduate physics course. The purpose of the study was to determine if tablets, computers, and DyKnow software have an impact on student test scores and if students have preference of technology over traditional instruction. The course was a core class for physics majors and covered relativity, atomic physics, and nuclear physics. To compare test scores, researchers compared scores of a class in 2005 with those of the current class in 2006. In the previous course, the instructor used a tablet; but the students did not. The 2005 course primarily used PowerPoint and annotations made with an electronic pen on the tablet to supplement lectures; the material was then posted online so that students had access to the notes right after class. In the 2006 class, 15 tablets were made available for use. Each student received their own tablet, which they were allowed to check out for use outside of class; the instructor also used DyKnow software for the course. The DyKnow software allowed the instructor to display all the classroom activities on his screen and also record class so that off-campus students still had access to the lectures. The results of the survey showed that students preferred the use of technology in the classroom when compared to other modes of instruction. The students also felt that the DyKnow software allowed them to take better notes and learn better. The main complaints about the use of the tablet were the network slowness, prewritten content and incompatibility with Apple products. The average test scores were shown to have increased slightly but there was not a large enough difference to be considered significant [Hrepic, 2013].

At Canada College in San Francisco, California, a series of studies was conducted to determine how tablet computers could be used in order to establish an interactive teaching model. A secondary purpose to the paper was to observe the effects of these interactions as well as collaboration on student performance. The subjects of the studies were students in a Circuits course required for engineering students at Canada College. The data for the studies were collected when the class was offered at Canada College in Spring 2005, Spring 2006, and Spring 2007 and was also collected at San Francisco State University in Spring 2007 because the same instructor taught the class. The number of students for each class was 41, 28, 16, and 46, respectively. The traditional approach for teaching the Circuits class was that the instructor would present lectures and examples in class and assign homework as well as give exams and quizzes for assessment. In these studies, a model the researchers refer to as the Interactive Learning Network (ILN) was used to supplement classroom instruction. The ILN was created with wirelessly connected tablet computers containing a program called “NetSupport School” which allowed for instructor and student interaction. In order to fully utilize the ILN, the instructor would lecture for less time than in traditional instruction and students would spend more in class time working on example problems which the instructor had access to. The students also were able to access the instructor's lectures through a PowerPoint program and take notes during the class using their tablet. NetSupport School allowed the instructor to survey the class during the lecture to check for understanding and receive instant feedback; the program also allowed students to submit questions individually if they were struggling with a certain concept or problem. The students in the classes had no previous experience with tablet computers. The first study was a comparison between the Spring 2005 class where the ILN was not used and the Spring 2006 class where the ILN was used. The instructor gave lectures using only chalk and the blackboard for the Spring 2005 course but used PowerPoint and the ILN for the Spring 2006 class. The second study occurred in Spring 2007 in a course at Canada College and a course at San Francisco State University taught by the same instructor; the course at Canada College still used the ILN but the course at San Francisco State University did not. Lectures at both institutions were given using PowerPoint supplemented with examples written on the tablet in the groups using the ILN; in the San Francisco State University course, however, the ILN and tablets were not used. The studies found that there was an increase of homework submission rate from 87% in the non-ILN groups to 95% in the ILN groups. In the second study, they found that the attendance rate increased from an average of 7.5 absences in the non-ILN class to 2.3 for the ILN class. They also found that students were willing to spend an average of 6.8 hours a week on outside assignments in the ILN group; whereas, they only committed an average of 5.4 hours a week to these assignments in the non-ILN class. The researchers observed gains in quiz and homework scores in the first study; and they observed gains in quiz and exam scores in the second study. From surveys, the researchers observed positive attitudes towards the use of the ILN in the classes that used them. The researchers felt that the improved performance may have been partially related to the fact that students were more confident in asking questions because they could submit them through the software anonymously; these questions also allowed the instructor to identify common issues and get them resolved before further confusion occurred. The researchers also speculated that the increase performance may be partly due to the increase in attentiveness of the class resulting from the random surveys the instructor gave as well as the knowledge that the instructor could observe their progress at any time. The study concluded that the ILN provided an effective learning environment in which student performance was enhanced due to more student-instructor interaction, more student engagement, and more individualized attention [Enriquez, 2010].

In a study at a major midwestern research university, pre-service teachers enrolled in a Masters of Education program were examined in their use of a computer program to build knowledge of the moon phases. A group of 50 students working towards their licensure for early childhood education was used for the study. The purpose of the study was to observe changes in the students' understanding of lunar concepts included in the teaching standards for their grade level by using a computer program known as "Starry Night Backyard". The course was taught using a combination of a textbook and the software. The goal of the instructor of the course was to use the activities to allow the students to correct their misconceptions and build a foundation of knowledge about the moon phases more accurate to the current scientific view. The instructor taught the course by first having the students collect and share data about the moon, then analyzing the moon data, and finally modeling the cause of the moon phases using "Starry Night Backyard". Before working with the software, the instructor gave the students instruction on how to use it. The software allowed the students to set the date, time, observation location, and view of the moon. The students were required to make daily observations which included a drawing of the moon's shape, the time of the observation, the direction they looked to see the moon, and the angular separation between the moon and the sun; these observations were recorded for nine weeks because it allowed the students to record two full lunar cycles. In addition to recording their observations, the students were asked to share data and discuss anything abnormal in their data with the rest of the class. After recording the observations, the students were asked to analyze their data by identifying patterns, determining the length of the cycle, sequencing the shapes, applying scientific labels, and modeling the cause of the phases. The students also were videotaped before and after completing the activities to test their knowledge growth. During the interviews, the students were asked to draw the observable shapes of the moon, explain how the shapes changed over the course of the month, and then explain the cause of the changes in the shapes of the moon. The researchers found in the pre-test that many of the students omitted many observable moon shapes and 96% included at least one non-scientific shape. Of all the students that had previously completed an astronomy course, only one drew accurate moon shapes; however, some weren't represented. Researchers also found that while only 4% of the students drew the moon phases accurately in the pre-test, 80% drew them accurately in the post-test. 82% of the students had a non-scientific representation of the pattern of the moon phases before the activity, but after using the software 80% drew scientific moon phases and 98% drew scientific moon phase sequences accurately. The ability of the students to draw both the moon phases and sequences accurately increased by 80%. Researchers concluded that the course when supplemented with the Starry Night Backyard software gave the students more scientific concepts regarding the moon phases by being able to observe and analyze them. They speculated that this improvement was partially due to the usability of the program as well as how the program was used in relation to the course overall [Bell, 2008].

CONCLUSIONS

The vast array of technology introduced to the world in the past few years has grown and evolved drastically; in order to adapt and evolve, society must remain educated in it. In order to demonstrate the importance of being educated in this technology, many studies have been done exploring its possibilities in classrooms across the globe while introducing it to students at all ages. These studies have used very different methods and types of technology ranging from tablet computers to laptop computers to even simulated environments and have been conducted in primary, secondary and post-secondary schools; but they can all be applied to the science classroom and all have reached very similar conclusions. One of the findings that most of the studies have agreed on has been the fact that technology cannot be a primary teaching tool [Bell 2008, Gazit 2005, Stern 2008, Waight 2007, Schmid 2008]. All the studies that used a tablet or a laptop as the only method to dispense information found that students did not fully comprehend the topics presented and even developed misconceptions based on their observations. In science classrooms, this outcome could be especially detrimental to learning because as students progress through science curricula, the information builds on itself; any misconceptions developed early on can cause a huge setback in education further along in students' careers. In addition to a lack of distribution of information, a lot of studies concluded that the teacher's attitude towards the technology had a drastic effect on the learning experience for the child as well [Loch 2013, Waight 2007, Schmid 2008]. If the instructor wasn't comfortable teaching using the technology, the students responded negatively to it. This of course applied to traditional teaching methods as well. In order to be an effective educator, teachers must have a large knowledge base available to provide information to the students; this is true of their knowledge of the subject matter as well as the technology they intend to use in the classroom. In fact, technology can even be used to help teachers gain this information in order to provide more accurate and useful instruction to their students [Bell, 2008]. Another common issue with technology use in the classroom was the fact that it did not always perform as it was intended [Galligan 2010, Loch 2006, Bell 2008, Hrepic 2013]. A lack of usability of the technology may occur partly due to user error by the instructors; but it could also very well be due to some malfunction in the technology itself. No matter the reason; when it doesn't work correctly, technology can be a hindrance or distraction from learning. Many of the studies did find that student performance increased in the classroom as a result of being able to use some form of media in the classroom [Yerrick 2010, Fund 2007, Kiboss 2004, Stern 2008, Hrepic 2013, Enriquez, 2010]. Researchers found that students are more engaged when interacting with technology, which directly impacts how much they learn. In science classes, it is especially important that students get a hands-on experience with topics so that they fully understand them. Technology provides a way to achieve this in many topics that were previously difficult to experience, such as the moon and cell theory [Bell 2008, Kiboss 2004]. They also found in multiple studies that the capability to communicate with the rest of the group as well as the instructor encouraged collaboration and increased individual attention [Enriquez 2010, Steward 2010, Baytak 2011, Chung 2006, Chen 2011]. In all classrooms taught by traditional methods, there are many activities that foster collaboration; however, with technology students can not only work together in the same room but from all over the country or even the world. Collaboration is important in the professional world in every field but is especially important in the field of science. Scientists share ideas in order to further each other's knowledge of various disciplines. The ability to collaborate with diverse groups of people is something that can be fostered by the use of technology in the classroom. Another crucial part of learning for a student is receiving feedback. Whether it comes from an instructor or fellow classmates, instant feedback provided by various technologies can be far more beneficial than having to wait especially in younger students with shorter attention spans [Galligan 2010, Freake 2008, Enriquez 2010, Chen 2011]. There also were skills students obtained from using the technologies in studies that were not directly related to science but could enhance the learning experience in a science classroom. The basic operation of a computer or tablet computer is something that many people take for granted today; however, every student does not have access to a computer at home. With basic computer skills being required for an increasing number of jobs, these skills need to be taught in the classroom. Many studies have shown that children as young as two can learn to turn on a computer as well as open programs and open and save files in addition to performing other tasks [Couse 2010, Schmid 2008, Chung 2006, Matthews 2007, Chen 2011, Baytak 2011]. Due to the fact that a lot of data collection and analysis software is available for the science classroom, these very basic skills can be put to use for more hands-on learning. Using a stylus on a tablet computer is another very useful experience to have. Tablets can be used to take notes or solve equations among various other applications [Galligan 2010, Loch 2006, Enriquez 2010]. The consideration for using technology as a tool for learning is not only necessary because of its ability to complement classroom instruction but also because of the variety of skills learned from using these various forms of media. In order achieve success in a world shaped by technology, students need to be taught to use the tools and gain the abilities necessary to attain

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