An Analysis of a Tablet PC Enhanced Learning Environment in the Agricultural Sciences

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Abstract

The purpose of this study was to analyze the perceptions of students and instructors in relation to the use of tablet personal computers (tablet PCs) in the learning environment of a Geographical Informational Systems/Geographical Positioning System (GIS/GPS) undergraduate course, offered within a university biological/agricultural engineering program. Students agreed that the incorporation of the tablet PCs into the learning environment heightened their overall learning experience, provided a more interactive learning environment and that the mobility of the tablet PCs allowed them to use GIS applications in a way that stationary units would not have facilitated. In this study, the instructors felt that the use of the tablet PCs enabled the class to do more and in a faster time. The instructors felt that the students were motivated and more interested in using the tablet PCs compared to traditional computers. In relation to gender, there were two statistically significant differences related to tablet PC use. Overall, the use of tablet PCs within the learning environment was perceived to have a positive impact for students enrolled in the GPS/GIS course as well as the instructors.

Introduction

Education is an ever-evolving method of disseminating knowledge from one person to another. As society continues to evolve and change for the better, so must education. Technology has grown extensively in a short period of time and for years educators have explored ways in which technology can aid with learning (Baguley, 2004). Globally, educators and professionals realize the importance of having students become independent thinkers, explore complex problems and apply the knowledge to real-life situations, which can be optimized by using technology within the classroom (Simonson and Thompson, 1997). With educators and professionals searching to find ways to incorporate instructional technology in education, many computer developers began to focus on creating tools that could enhance hands-on learning activities as well as provide an easier way to stay connected to the students both inside and outside of the classroom (Nah et al., 2005). These aforementioned concepts grew into what is now called mobile education or mobile learning. Mobile technologies have provided unique opportunities for educators to deliver educational materials efficiently and to support the cognitive and social processes of student learning. Students can communicate and interact

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with their peers, classmates and educators in real-time using mobile technology. Mobile technology can also be integrated into curriculum design to improve interactivity in the classroom (Nah et al., 2005).

The aforementioned topic of mobile technology plays a vital role within instructional technology today. Technologies, such as the tablet PC, is a tool used to help provide information literacy to educators, learners and professionals alike. The tablet PC is a technology tool based upon interactive pen-based computing. Released in 2002, the tablet PC has grown tremendously in popularity, particularly among educators. These computers run on a variety of platforms with an active screen for pen-based computing. The hard drives of tablet PCs today are just as powerful as many desktop machines with the added bonus of mobility. The screen on a tablet PC allows the user to complete multiple interactive tasks (Mock, 2003). Educators and professionals alike have begun to utilize tablet PCs in their fields. Educators use the tablet PC as a hands-on learning tool that can travel both inside and outside of the classroom. Professionals are using the mobility of the tablet PC to assist in numerous tasks such collecting data or formulating GIS (Geographic Information Systems) maps directly into the tablet PC. The ability to have access to technology outside of the traditional four walls of a classroom or office is of great appeasement to those who use the tablet PC. As time goes on and technology improves, it is safe to say that the tablet PC use in society will increase (Hewlett-Packard, 2008). Given the aforementioned factors what impact could such technology have upon the agricultural instructional environment, particularly within a GIS-biological engineering course? The National Research Agenda for Agricultural Education in Priority 2 emphasizes the development of new technologies and practices in order to disseminate agricultural knowledge to a plethora of stakeholders (Doefert, 2011).

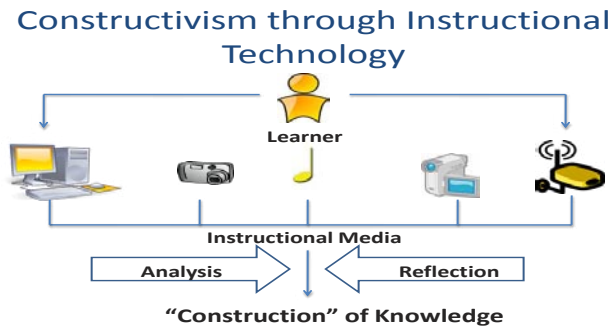
Theoretical Framework

Ormrod (2008) defined a theory as an explanation about the underlying mechanisms involved in learning. Ormrod (2008) also stated that theories serve two purposes: (1) allow one to summarize the results of many research studies and integrate numerous principles of learning and (2) theories provide starting points for conducting new research. Simonson and Thompson (1997) stated, "Theories can provide direction to the practice of a profession" (p. 147). In the field of instructional technology there are several theories that guide the focus of research and practice. These theories include constructivism, which will serve as the basis of this study.

Constructivism

In recent decades, it has become apparent that many learners do not simply absorb educational information as they encounter it. Some people actively try to organize and make sense of newly acquired information, often in unique, idiosyncratic ways. Constructivism is founded on the belief that "*there is a real world that is experienced but that meaning and understanding of the world are imposed by the person*" (Simonson and Thompson, 1997, p. 43). Today, many cognitive theorists now portray learning more as constructing knowledge rather than directly acquiring it from the outside world (Ormrod, 2008). Constructivists believe that learners create their own meaning from instructional activities and real-world experiences as described in Figure 1. Through these experiences with various forms of instructional media, meaning is gained, which can be utilized through the use of instructional technology (Simonson and Thompson, 1997).

Figure 1. Constructivism through Instructional Technology Model



Purpose and Objectives

The purpose of this study was to determine the perceived impact on tablet PC use within a biological and agricultural engineering environment. To accomplish the purpose, the following research questions were developed:

1. What was the perceived impact of tablet PC use upon the instructional environment within a biological and agricultural engineering course as perceived by students?
2. What was the perceived impact of tablet PC use upon the instructional environment within a biological and agricultural engineering course as perceived by instructors?
3. What was the perceived impact of tablet PC use by demographics of the study participants?
4. What were the demographic characteristics of the study participants?

To test the demographic research question the following hypothesis were identified:

- H01. There are no differences in perception of

tablet PC use by a student's gender within a biological and agricultural engineering course.
- H02. There are no differences in perception of tablet PC use by a student's major within a biological and agricultural engineering course.
- H03. There are no differences in perception of tablet PC use by a student's classification within a biological and agricultural engineering course.

Methodology

The population for this study consisted of students enrolled in a sophomore-level Geographic Information System course at a land grant university. Participants (n = 46) were recruited over a two-semester time frame in which the study took place. The same instructors (n = 2) taught the course for each of the two semesters. At the time of this study, surveys suitable to meet the research objectives were not found; therefore, two separate survey instruments were developed by the researchers based upon the research questions for this study and with the aid of an exhaustive literature review. The first survey instrument was entitled GIS Tablet PC Evaluation - Student Form. This survey instrument was comprised of one section of seven Likert-type questions consisting of the following responses: 0=Neutral, 1=Strongly Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Agree and 5=Strongly Agree. Additionally, combinations of both open and closed questions for demographic purposes were asked. The second survey was entitled GIS Tablet PC Use - Professor Reflection Form. This survey was comprised of three open-ended questions about tablet PC use. This study was approved by the NC A&T State University Institutional Review Board, which included informed consent notification for participants given in the form of a consent form with the survey.

The validity of the instruments was established by means of content and face validity. Brown (1983) defined content validity as "the degree to which items on a test representatively sample the underlying content domain" (p. 487). Brown recommended using expert judges as one means of establishing content validity. A panel of experts at the Land Grant University with expertise in the content reviewed the survey instrument for content validity. After the reviews were conducted, the surveys were considered to be valid based upon the research questions of the study. In order to establish the reliability of the survey instruments, a post-hoc test was conducted with students enrolled in the GIS course. The Cronbach's alpha reliability coefficient for the student survey was .88.

In reference to data collection, a post-course methodology was employed for students enrolled in the biological and agricultural engineering GIS course as well as the instructor. The students were asked to provide their perceptions of using tablet PCs in order to learn GIS concepts in the course, 46 surveys were returned. Additionally, the instructors were asked to provide their perceptions of the impact of tablet PC use within the course. The data collected from the respondents were coded, entered and analyzed using the Statistical Package for Social Science (SPSS), Personal Computer Version 18.0.

Findings

Research Question One

Students in the course were asked to share their views about the impact of tablet PC use on their instructional environment. Table 1 displays the mean and standard deviation (SD) regarding their perceptions. The following specifications are provided to interpret the scale for the table: 0.00-0.99=Neutral, 1.00-1.49=Strongly Disagree, 1.50-2.49=Disagree, 2.50-3.49=Undecided, 3.50-4.49=Agree and 4.50-5.00=Strongly Agree.

Table 1. Perceived Impact of Tablet PC Utilization upon the Instructional Environment

Student Perception	M	SD
1. The mobility of the laptop allowed me to do GIS applications that stationary units would not have facilitated.	4.24	0.993
2. The use of tablet PCs provided a more interactive learning environment.	4.09	0.890
3. The instructors provided adequate instructions on how to utilize the tablet PC in relation to GIS.	3.98	1.064
4. Overall, the utilization of tablet PCs enhanced my learning experience in relation to GIS.	3.96	.942
5. Utilizing the tablet PC for GIS applications increased my overall technological literacy.	3.65	1.079
6. After the utilizing the tablet PC equipment with Arc GIS, I am now more knowledgeable of GIS.	3.63	0.997
7. The use of tablet PCs improved my overall knowledge base regarding GIS.	3.52	1.150

In relation to the impact of tablet PC use, students agreed that the mobility of the tablet PC allowed them to complete GIS applications that stationary units would have not facilitated. Students agreed that the use of tablet PCs provided a more interactive learning environment. In reference to tablet PC use in the instructional environment, students agreed that the instructor provided adequate instructions about how to use the tablet PC in relation to GIS. Students agreed that overall, the use of the tablet PC enhanced the learning experience in relation to GIS. In relation to GIS applications, students agreed that using the tablet PC for GIS applications increased overall technological literacy. Lastly, students agreed that using the tablet PC for GIS applications increased overall technological literacy.

Research Question Two

The second research question asked the instructors of the course to share their views about the students' use

of the tablet PCs with respect to GIS instruction. The responses from the instructors' reflection form were as follows:

1. What are the most valuable aspects of incorporating the mobile technology into the GIS/GPS course?

Fall Semester

"The students can immediately see the relevance of the lecture to field work. In the future classes, the mobile aspect will be introduced a little earlier so that students will be able to work with their own data (based on their major) to get a feel on how GIS/GPS can be applied to their field of study and thereby become more connected to the process. You can see the work instantly in a simpler process than with the alternate method."

Spring Semester

"The mobile technology requires fewer steps to get a task completed. The students were more interested in using the tablet and its external device in a simple process rather than a more complex and tedious process. Students were exposed to current technology and tools that they will likely encounter in their jobs after graduating."

2. What challenges have students faced with the mobile technology in relation to GIS instruction?

Fall Semester

"There were a few issues with connectivity. It was also a bit rushed. The monitors of the tablet PCs were hard to read in the sunlight. The students did not realize that they could and should have deactivated the GPS component before and after taking points to avoid unwanted lines or courses. More time will be allocated to field techniques and other efforts in the future."

Spring Semester

"It is difficult to see the screen on a sunny day. It was a challenge, though not insurmountable, to get the GPS unit 'talking to' or seeing to the computer. The stylus is not user-friendly and not easy to set for one individual since several students will use a given unit in each semester. The mouse is tiny and difficult for large-fingered students to work with."

3. Overall what is your general impression regarding the incorporation of the mobile technology into the GIS/GPS course, particularly compared to past sections of the course?

Fall Semester

"The students appreciated the fact that several steps were eliminated in getting their data into shapefiles. It is the opinion that they (students) were more motivated as well because the tablets were fun to work with since using the hand held GPS units require several steps to get the data in the form of a shape file."

Spring Semester

"The instructors and students were impressed with the units. The PCs enable us to do more and do so faster since certain steps were eliminated or reduced. In comparison with a former approach, the students were able to undertake additional projects where in the former approach they were unable. In one case, one team was able to complete their project and was able to assist another group. This was not observed in past sections. In previous sections prior to the use of the tablet PC, students would struggle to complete a medium-sized task. The ability to teach at a faster pace through the use of the tablet PC is very beneficial to the course."

Research Question Three

In the fourth question of the study, the researcher tabulated the perceived impact of tablet PC use by the demographic variable. With regard to question two, there was a statistically significant difference by gender as revealed by a T-Test (Table 2). Males agreed that tablet PCs provided a more interactive learning environment in contrast to the females who only somewhat agreed. There was also a statistically significant difference in responses by gender in question six. Males agreed that after the using the tablet PC equipment with Arc GIS, they were more knowledgeable of GIS. Females, however, only somewhat agreed. Based upon the aforementioned results, the researchers rejected the null hypothesis of no differences in Tablet PC use perception by student gender.

Table 3 lists the perceived impact of tablet PC use upon the instructional environment by class. ANOVA testing was done to determine if any differences existed.

Table 2. Perceived Impact of Tablet PC Utilization by Gender

Gender Perceptions	Gender	*M*	*t*	*p*
1. The mobility of the tablet PC allowed me to do GIS applications that stationary units would not have facilitated.	Male Female	4.20 3.73	1.561	0.126
2. The use of tablet PC's provided a more interactive learning environment.	Male Female	3.71 2.91	2.102	*0.041
3. The instructors provided adequate instructions on how to utilize the tablet PC in relation to GIS.	Male Female	4.09 3.64	1.228	0.226
4. Overall, the utilization of tablet PC's enhanced my learning experience in relation to GIS.	Male Female	4.34 3.91	1.272	0.210
6. After the utilizing the tablet PC equipment with Arc GIS, I am now more knowledgeable of GIS.	Male Female	3.80 3.09	0.924	*0.038
7. The use of tablet PC's improved my overall knowledge base regarding GIS.	Male Female	4.03 3.73	2.138	0.361

Note, *p <0.05= statistically significant difference

The study participants were those students who were enrolled in the course over a two-semester time frame. There were no statistically significantly differences based upon class, thus the researchers failed to reject the null hypothesis of differences by class.

Table 3. Perceived Impact of Tablet PC Utilization by Class

Class Perception	*F*	*p*
1. The use of tablet PCs provided a more interactive learning environment.	0.929	0.457
2. The use of tablet PCs improved my overall knowledge base regarding GIS.	0.292	0.881
3. The instructors provided adequate instructions on how to utilize the tablet PC in relation to GIS.	0.720	0.583
4. The mobility of the tablet PC allowed me to do GIS applications that stationary units would not have facilitated.	0.681	0.609
5. Utilizing the tablet PC p for GIS applications increased my overall technological literacy.	0.886	0.481
6. After the utilizing the tablet PC equipment with Arc GIS, I am now more knowledgeable of GIS.	0.968	0.435
7. Overall, the utilization of tablet PCs enhanced my learning experience in relation to GIS.	1.046	0.396

Note, *p <0.05= statistically significant difference

Table 4 addresses the perceived impact of tablet PC use on the instructional environment by major. The study participants were students enrolled in a BIOE 216 Geographic Information System course over a two-semester time frame. The survey was distributed by the instructor and completed by the study participants at the conclusion of the course. ANOVA testing was done to determine if any differences existed. The table shows that there were no statistically significantly differences based upon major, thus the researchers failed to reject the null hypothesis of differences by major.

Table 4. Perceived Impact of Tablet PC Utilization by Major

Major Perceptions	*F*	*p*
1. The use of tablet PCs provided a more interactive learning environment.	.795	.634
2. The use of tablet PCs improved my overall knowledge base regarding GIS.	.762	.663
3. The instructors provided adequate instructions on how to utilize the tablet PC in relation to GIS.	.341	.963
4. The mobility of the tablet PC allowed me to do GIS applications that stationary units would not have facilitated.	.476	.894
5. Utilizing the tablet PC for GIS applications increased my overall technological literacy.	.593	.808
6. After the utilizing the tablet PC equipment with Arc GIS, I am now more knowledgeable of GIS.	.507	.873
7. Overall, the utilization of tablet PC's enhanced my learning experience in relation to GIS.	.935	.514

Note, *p <0.05= statistically significant difference

Research Question Four

Table 5 addresses the demographic data of the students who participated in the survey. In relation to the semester in which students were enrolled, 54.3% of the students were enrolled in the fall semester and 45.7% of the students were enrolled in the spring semester. In relation to gender, 76.1% were males and 23.9% were female. In relation to the classification of students, 19.6% were freshmen, 39.1% sophomores, 30.4% juniors, 8.7% seniors and 2.2% graduate level.

Table 5. Demographics of Students

Demographics	*n*	%
Semester:		
Fall 2008	25	54.3
Spring 2009	21	45.7
Gender:		
Male	35	76.1
Female	11	23.9
Classification:		
Freshman	9	19.6
Sophomore	18	39.1
Junior	14	30.4
Senior	4	8.7
Graduate	1	2.2
Major:		
Civil Engineering	24	52.2
Biological Engineering	9	19.6
Architectural Engineering	2	4.3
Bioenvironmental Engineering	2	4.3
Mechanical Engineering	2	4.3
Soil Science	2	4.3
Agricultural Business	1	2.2
Construction Management	1	2.2
Environmental Science	1	2.2
Landscape Architect	1	2.2
Technology Education	1	2.2

Conclusions

Students who were enrolled in the GIS/GPS agreed that the incorporation of the Tablet PCs into the learning environment heightened their overall learning experience. These students agreed that the tablet PCs provided a more interactive learning environment and that the mobility of the tablet PCs allowed them to do GIS applications that stationary units would not have facilitated. These positive perceived impacts are supported by Beam (2008), who stated that the application of mobile technology in education can provide benefits to both students and educators. Mobile technology provides greater flexibility in student learning. Students can have access to educational materials through their mobile devices, which enables them to learn when the need arises and when the time is right for them, no matter where they are—even when they are on the move. This indicated that as perceived by students, tablet PCs have a positive impact upon the learning environment (Beam, 2008). Shuler et al., (2010) indicated that students perceived table PC's to have a positive impact upon the learning environment, in addition to increasing cooperative learning and enhancing technological competence.

Simonson and Thompson (1997) stated that many experts in the field of education realize that technology is an essential component to support the academic world. Although education once relied only on books, chalkboards and teachers, education now uses technology to enhance the learning environment. In this study, the instructor felt that the use of tablet PCs "enabled the class to do more and do so faster." The instructor felt that the students were more motivated as well because the tablets were fun to work with since using the hand-

held GPS units required several steps to get the data. The instructor also felt that students were more interested in using the tablet and its external device because of its simpler process to complete a task in the course. These findings are supported by Swan et al. (2005), who stated that *"many teachers are finding that once they incorporate technology in the classroom, it benefits their students by engaging them in ways they are familiar with and enjoy, which ultimately makes their job easier"* (p.270). These findings indicate that instructors feel that the use of tablet PCs in the learning environment are positive.

In relation to gender, there were two statistically significant differences related to tablet PC use. Females "somewhat agreed" that the use of tablet PCs provided a more interactive learning environment when, in contrast "males agreed." Females also "somewhat agreed" that after using the tablet PC equipment with Arc GIS they were more knowledgeable of GIS, while males within the course "agreed." Chaika (1999) found that males and females have a tendency to view computers differently in their use. Males tend to perceive technology as mechanical tools, while females tend to perceive technologies as social tools (University of Illinois, 2011). The masculine hands-on nature of the tablet PC caters more towards males than females, which can alter the perception of its usefulness in regards to the female perspective (The Center for Women and Information Technology, 2011; Kay, 2007). Though the perception of tablet PCs use within the learning environment varies by gender, overall, the use of the tablet PC in the learning environment is perceived to be positive. The demographic data showed that there were no statistical differences based upon major or classification.

Recommendations

Overall, the use of tablet PCs within the learning environment was perceived by students and the instructor to have a positive impact. After analyzing the data in this study, the following recommendations were made:

1. Instructors within the biological and agricultural engineering program could consider more activities that utilize instructional technology in the learning environment.
2. Instructors within the biological an agricultural engineering program could incorporate the use of mobile technology into the learning environment.
3. Instructors within the biological and agricultural engineering program could develop evaluation plans to identify the impact that instructional technology has on their respective courses.
4. Instructors within the biological and agricultural engineering program could develop and incorporate instructional methods of teaching that are not gender biased in the learning environment.

Implications

Educators across the globe are undergoing major changes in curricula to incorporate instructional delivery approaches. As these changes occur, programs within the field of agriculture have realized that instructional technology is a major area of concern. This concern has motivated educators to use instructional technology in the classroom. The findings of this study showed the importance of instructional technology to learning environments within the collegiate setting, especially computer-based technologies. This research study indicated the importance of the use of instructional technology in agriculturally based learning environments. Perhaps the results of this study could provide teachers within the field of agriculture a foundation upon which to create and implement methods for the infusion of instructional technology into the education curriculum. If implemented effectively, instructional technology can positively impact students' learning within agricultural learning environments. This trend could lead to the creation of more interactive, multi-media computer software and internet sites focused on the individual student's exploration of new agricultural knowledge and greater use of their cognitive skills. Instructional technology infusion into learning environments within the field of agriculture will provide students with many avenues for learning and exploration. Instructional technology should be utilized as a tool for enhancing instruction in learning environments in the agricultural sciences.

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