

**AC 2010-383: A TECHNOLOGY-ASSISTED SIMULATION OF
DISTRIBUTED-TEAM IT SOLUTION DEVELOPMENT**

Julio Garcia, San Jose State University

William Cruz, National Hispanic University

A Technology-Assisted Simulation of Distributed-Team IT Solution Development

Abstract

Using HP mobile technology, students transformed their vision of teamwork then designed and implemented IT solutions addressing challenges posed through lecture and lab. In addition, faculty members not immediately involved in the grant learned how to use technology by seeing its use in the project classroom.

The goals of this study were how students' collaborative and dynamic use of technology will transform their vision of teamwork to solve problems and determine the impact of the Tablet PC in improving students' learning.

Background

The institution is a small university whose mission is to empower minorities to achieve their full potential. Being a minority institution many students do not have the resources to purchase a computer and this widens the digital divide. Thanks to the HP grant in 2007 computer science students became familiar with computers, Internet browsing, Internet research, and experienced the utility of Tablet PCs as tools for learning, keeping notes, and connecting disparate pieces of data so that they attained the utility of information. Having all lectures online allowed students to review the material at their own pace and at their own convenience. In the selected course CS 360: Object Oriented Analysis and Design course, students designed two projects: one related to Decision Support Systems and the other to Database Design. In the other computer science classes, CS 101 "Introduction to Programming," CS 105 "Object-Oriented Programming I," and CS 106 "Object-Oriented Programming II" students were able to do many exercises efficiently, deepen their facility with programming procedures, watch movies and other videos supportive of the material being taught, access professors' lecture notes at their convenience, and engage in self-tests tailored to ensure that students understood the level at which they grasped the material. Some testing was done outside the class. These efforts combined gave the instructor extra time for teaching and making sure those students learned the material well. Instructors also checked which questions were difficult for students and adjusted the material appropriately. Moreover, classes became more dynamic and promoted teamwork skills.

In contrast, three years ago, there was little use of computers in doing internet research, minimal teamwork skills, and students were passive. Today, the use of the Tablet PC allows students to work in teams. Students use the Tablet PC more heavily in most of their computer science classes. There is continuous active participation and use of the Internet in solving problems, and constant communication among students and the instructor. The PI has done intensive and extensive research and applications of the Tablet PC and several software packages, so he is in the position of assisting faculty in selecting the right software for a particular class or activity to ensure students learn and actively participate. The Tablet PC is also used by students taking Physics and Chemistry in the Math/Science department.

2007-2008 Assessment

The SALG (Student Assessment of Learning Gains) instrument was used to collect compelling evidence and determine the effectiveness of the course. The Student Assessment of Learning Gains (SALG) was originally designed for assessing chemistry teaching and learning in over 100 two- and four-year institutions.¹ The National Science Foundation funded this project for five years (1995-2000) as part of two, linked consortium, “ChemLinks” and “ModularChem.” The SALG instrument was modified to meet the needs of this course. This instrument uses the Likert scale where 1 was “very little” to 5 “the most.” Based on the students’ responses from 2007, the use of Tablet PCs has improved the teaching/learning process close to above average (3.82 out of 5.00) in the CS 360 “Object Oriented Analysis and Design” course.

The SALG (Student Assessment of Learning Gains) instrument was used to collect compelling evidence and determine the effectiveness of the course.



In a survey given to students at the beginning and at the end of the course, students indicated that as a result of using the Tablet PCs, their skills for using the Internet were rated **high** for specific purposes like research for courses; they **became familiar** in using course management software (Moodle and Yugma); **asked** more questions of the instructor; **corresponded** more frequently with the instructor; **worked** in groups; and **increased** the frequency of taking notes during class.

2008-2009 Assessment

The National Hispanic University (NHU) and San Jose State University (SJSU) both located at San Jose, California have been educational partners since 1998. These two institutions have a cross-enrollment agreement that allows students from either institution to take up to six units per semester at the other institution. The PI used the Tablet PC and Ubiquitous Presenter (UP) at a class at SJSU. The class was Tech 166 “Networking Management and Administration” which is equivalent to CS 322 “Client Administration” at SJSU. This class was taught in spring 2009. Among the reasons were that the PI taught this class in spring 2008 so he has a baseline already

and the majority of the student body was non-Caucasian, similar to NHU's classes. The number of students enrolled in Tech 166 was 28; three women and 25 men. Of these 28 students, 21 were minorities and 7 were Caucasian. Students in both classes took four quizzes, two midterms and a final exam.

The class was conducted in a computer lab at the College of Engineering at San Jose State University. The PI used an HP Tablet PC and the majority of students used the workstations; some students use their own laptops and one student purchased an HP Tablet PC after seeing all its advantages in her learning. The software used was Ubiquitous Presenter (UP). Students were presented with questions where they had to work in groups and submit their work. The PI reviewed all submissions and then selected the best ones and showed them to the class for further discussion or clarification. It was very interesting to note how students were engaged during the whole class doing Internet research, discussing among themselves or reviewing their textbook for hints. At the end of each lecture, each student was asked to provide the answer to one question to ensure that they were able to function individually and to motivate them to actively participate in their own learning. Ubiquitous Presenter proved to be very beneficial for students who couldn't attend a lecture or for students to review the material before taking a test. They could do this from any computer connected to the Internet at their own time and at their own pace. Another advantage is that the instructor faced students all the time which was very important to students as they indicated in their comments.



The instructor's Tablet PC was logged in to Ubiquitous Presenter (UP) as an instructor and a snapshot of one slide is depicted in Figure 1. Notice that this slide has questions and the answers are shown below the questions. A workstation logged in to UP as a student was connected to an LCD projector. The projected screen is depicted in Figure 2. Notice that it shows only the questions but not the answers. This feature is very helpful for instructors because it provides hints to solve problems, designs, use of equations, etc. Typically, students log in to UP through a student account and see what is depicted in Figure 2. In this manner, students follow the lecture on their respective workstations' screens which is also projected through the LCD projector on a big screen. The instructor may then move freely in the room with his Tablet PC, giving him/her

the flexibility to test students throughout the course, accept student submissions and project the ones with the correct answers so that other students can compare their answers. Figure 3 depicts the instructor's Tablet PC with the answers written with the Tablet PC pen, and Figure 4 shows the students' workstations screens with the answers.

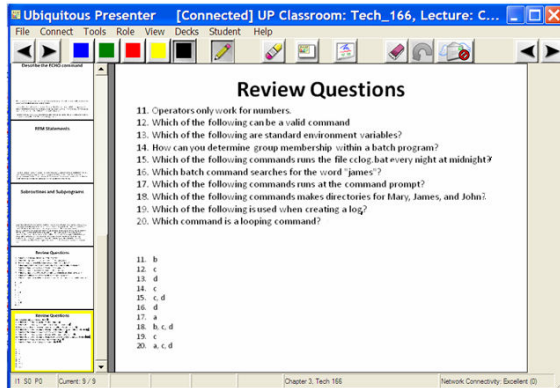


Figure 1. This is a snapshot of the Instructor's Tablet PC before writing down the answers with the Tablet PC pen.

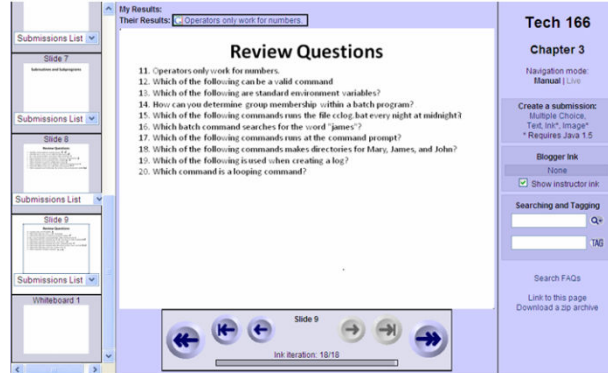


Figure 2. This is a snapshot of what is projected on a screen and what students see on their workstations.

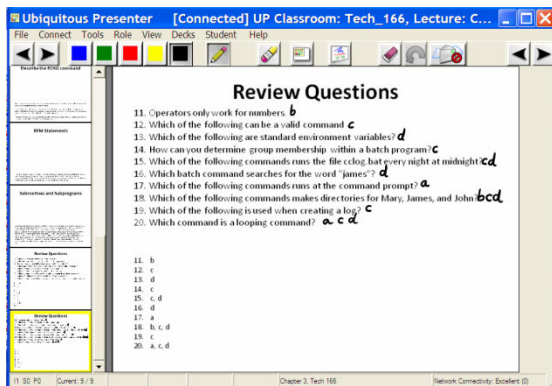


Figure 3. This is a snapshot of the Instructor's Tablet PC after writing down the answers with the Tablet PC pen.

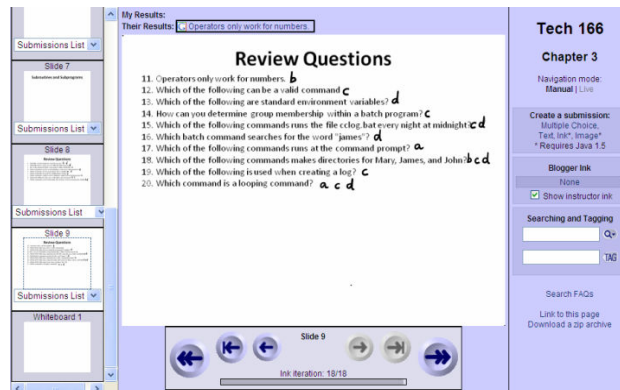


Figure 4. This is a snapshot of the students' workstations with the correct answers. This image is also projected on a screen.

At the end of the semester the students' performance in Quizzes, Midterms and Final Exam were compared with the 2008 baseline as shown in Table 1 below. The students who took the same class in 2009 increased their performance by 7.4% in quizzes, 6.8% in Midterms and 4.9% in the Final Exam.

Table 1. Comparison of students' performance in TECH 166 in years 2008 and 2009

	Quizzes Average	Midterms Average	Final Exam Average
2008	85.4	84.9	89.5
2009	91.7	90.7	93.9
% change	+ 7.4%	+ 6.8%	+ 4.9%

Students also took the SALG (Students Assessment of Learning Gains) instrument which was partially modified. The proposed questions and the results are shown in Table 2 being 5.0 the highest and 1.0 the lowest.

Table 2. SALG results (n = 20)

Number	Question	Mean
	The Class Overall	
1	HOW MUCH did the following aspects of the class HELP YOUR LEARNING?	
1.1	The instructional approach taken in this class	4.4
1.2	How the class topics, activities, reading and assignments fit together	4.3
1.3	The pace of the class	4.2
	Class Activities	
2	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	
2.1	Attending lectures	4.3
2.2	Being able to write my answers and submitting them to the instructor for immediate feedback	4.1
2.3	Specific Class Activities	
2.3.1	Ability to answer to the questions proposed by the instructor	4.1
2.3.2	Ability to answer the quiz questions and get immediate feedback	4.5
2.3.3	Use of the Tablet PC which allows the instructor to write the correct answer by each question	4.8
2.4	Use of the workbook so I came prepared to class	4.3
2.5	Combination of the Instructor's Tablet PC with the lab network and some personal Laptops.	4.5
	Assignments, graded activities and tests	
3	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	
3.1	The feedback on my work received after tests or assignments	4.1
	Class Resources	
4	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	
4.1	Online notes or presentations posted by instructor	4.7
	Support for you as an individual learner	
5	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	
5.1	Working with peers outside of class (e.g., study groups)	4.3
	Increases in your skills	
6	As a result of your work in this class, what GAINS DID YOU MAKE in the following SKILLS?	
6.1	Writing documents in discipline-appropriate style and format	4.2
	Class impact on your attitudes	

7	As a result of your work in this class, what GAINS DID YOU MAKE in the following?	
7.1	Your willingness to seek help from others (teacher, peers, TA) when working on academic problems	4.2
	Integration of your learning	
8	As a result of your work in this class, what GAINS DID YOU MAKE in INTEGRATING the following?	
8.1	Using a critical approach to information and arguments I encounter in daily life	4.0

Students were given the opportunity to provide comments on how the instructional approach to this class and how the class activities helped their learning.

Please comment on how the INSTRUCTIONAL APPROACH to this class helped your learning.

I loved it being online! Learned that Windows server 2003 existed between XP and Vista. I appreciate the instructor's hard work to make this class valuable. Online quizzes and midterms help understand the material more in depth. We went through the book regularly and the presentations were good. It was nice because it was different, but sometimes the pace of the class was a little fast. Should be an online course. Hands-on experience and interactive learning.

Please comment on how the CLASS ACTIVITIES helped your learning.

The immediate quizzes after lecturing. up.ucsd is very good for lectures Class was interesting It helps me know what is right and wrong almost immediately.

From Table 2 it is interesting to note the five tasks ranked the highest by students:

1. Use of the Tablet PC which allows the instructor to write the correct answer by each question (4.8)
2. Online notes or presentations posted by instructor (4.7)
3. Combination of the Instructor's Tablet PC with the lab network and some personal Laptops (4.5)
4. Ability to answer the quiz questions and get immediate feedback (4.5), and
5. The instructional approach taken in this class (4.4).

This rank is in line with what was expressed by students in writing. Overall, students were very satisfied with the instructional approach used in this class using the Tablet PC. This resulted in an increase in performance as shown in Table 1. Students taking the Tech 166 class in spring 2009 scored higher than the students who took the same class in spring 2008 by 6.4%.

Student Quotes

Selected quotes from students describing the impact that the project had on their learning at The National Hispanic University and San Jose State University are as follows:

1. The HP tablet has made it much easier to keep all my assignments and notes in one place. Outside of the classroom, I was able to collaborate with my classmates over the internet whether it is via WiFi at a coffee shop or plugged into my network at home.
2. It has been a great tool for my courses especially CS380 LabVIEW. I have learned many things using my tablet PC like when I had my UNIX class during the summer, and also a number of other classes, so the Tablet PC has been a big help because I have no Laptop of my own.
3. It's always a good experience to take advantage of newer technologies and working with these Tablet PCs has not been an exception. Just the fact that you can pretty much turn them into digital notebooks where you can write and/or draw has had an important impact in the way we do things at the classroom.
4. HP Tablet PC is usable for the computer science major students to use, because one can do all of the assignments that one is given & is usable at any point of time, & as well you don't need to carry notebooks, pens & other materials. It has been helpful in my two classes that I have taken: CS 380 & CS 360.
5. I feel the use of the Tablet PC is excellent because it provides printed material on the board and has interactivity. Ubiquitous Presenter was very good because it was synchronized to every screen and kept attention. We can always refer back to UP for in-class lecture notes from the professor.
6. The Tablet PC helps with the continuous flow of lectures. Ubiquitous Presenter is great in the sense of remote logins. I really like the teaching style using the Tablet PC and UP. It helps us to be more interactive with the instructor and rest of the class. Lectures can be viewed at home when reviews are needed.
7. Ubiquitous Presenter was helpful because students who could not attend class could follow along the lecture at home or logon later and see the lecture. The Tablet PC was faster and a bit easier than a usual whiteboard. It is a great piece of technology.
8. The Tablet PC was a faster method of lecturing than the chalk/whiteboard. For Tech 166 (Networking) the Tablet was useful because of the layout of the class. UP was also very convenient for quick feedback. Also, being able to access from home.
9. My experience with UP and using the desktop to participate was really great because we were able to get feedback right away and the instructor faced the class so we were able to ask questions if we needed help. We were able to follow from home if we were sick.
10. The Tablet PC was useful in keeping us alert. Rather than speak to the professor's back when writing on the whiteboard, the Tablet PC allowed us to be face to face with the presenter which make it easier to ask questions during a presentation rather than after. The Ubiquitous Presenter, though difficult to pronounce, was beneficial to keeping the class alert. Being able to interact with fellow classmates to collaborate with answers was a key aspect of the presenter. Plus, receiving immediate feedback notifies us of our mistakes while the material was being learned rather than weeks after.

Impact on Teaching

Some specific examples of how this project has influenced the PI's instructional practices and what the PI was able to accomplish in his teaching that would not have been possible without the Tablet PC technology are as follows:

1. In the past, the researcher spent a lot of time lecturing; this made students passive and they were bored after 10 to 15 minutes. Even though he emphasized teamwork and gave them problems in class, he felt that the students needed something more. With the Tablet PCs, the researcher lectures less and students work more on their own learning; he acts more as a facilitator of learning. Students are able to use the appropriate software, do Internet research on the spot, collaborate amongst themselves and discuss the solution or better ways to solve the assignments. The researcher sees right away the increased level of excitement among students and myself for teaching/learning.
2. Given the small classes we usually have at The National Hispanic University, 12 students maximum in the upper division classes, each student is given a Tablet PC at the beginning of every semester and is expected to take care of it. Students carry their Tablet PCs all the time, and they use them not only for the classes the researcher teaches but for all the classes they are taking. Since the lecture materials and assignments are online, students can handle their work, school, and family activities with little conflict. In the past, students missed classes due to work conflict, and there was no way to make up these classes because these students cannot afford a computer. Now, the researcher feels that the class is not limited to the scheduled time but it is 24/7; students can review the lecture materials at any time and at any place with access to the Internet. The assignments can be submitted electronically, graded and returned the same way. In this way we are not only being ecological but it is much easier to control electronic files than hard copies.
3. When we meet in class, students can submit their assignments right away and almost immediately know if their answers were right or wrong. I allow students to resubmit their assignments to improve their grades and the majority does that. In this manner, students learn from their mistakes and also learn the right way. On the other hand, students are motivated because they know that they have a second chance. The use of Tablet PCs encourages students to correct their mistakes and resubmit their assignments.
4. The instructor can communicate with students at any time through email, Blackboard or Moodle. In this way, he can send them an assignment or any information that might be of interest to them at any time he wishes to do so. Students can also communicate with the instructor 24/7. This changes the concept of a "class" fundamentally.
5. When students show up for class, they start working on their Tablet PCs right away. They learn at their own pace, and they review the concepts that they need in order to submit the required assignments. Since students learn at different paces, they don't have to wait for the instructor to explain concepts to the whole class. Students who already know the material tend to get bored when concepts are conveyed through lecture, and the ones who don't know the material run the risk of becoming confused. The Tablet PCs allow the fast students to move even faster. At the same time, the Tablet PCs allow the students who need more time to explore ideas until they are confident with the material. Students need to solve problems related to the material for that particular session. Still, each student needs to accomplish a

certain set amount of work in a class period. In addition to these different paces of learning, our students are from a group that is underrepresented in higher education generally. These students have learning styles that are not uniform, and are often not what would be encountered in a college classroom comprised of students from economically secure families whose parents had attended college. It is crucial that use of the Tablet PC helps accommodate these learning styles.

6. Students take notes right on their Tablet PC. This allows them to keep their notes organized so they can find them quickly when they need them for review.
7. The digital divide that existed for these low-income students before we received the HP grant has been reduced among the Computer Science and Math/Science students. Now students are more engaged in their learning, work cooperatively amongst themselves, correspond more frequently with the instructor and have become very experienced in using course management software such as Moodle and Blackboard.
8. The use of Ubiquitous Presenter (UP) in the researcher's teaching has proven very valuable during lecture because it encourages students to remain engaged in class, get immediate feedback and review the material whenever they need. For students who miss a class they do not get behind because they can review the entire lecture including the instructor's notes from any computer with access to the Internet, at their own pace and at their most convenient time.

As a result of this new teaching strategy, we gained the following: 100% retention rate, improved quality of learning materials, growing sophistication in group work to solve problems, facilitated library and Internet research to answer questions, increased availability of the instructor to answer questions in a timely manner, increased interaction among students and between students and the instructor, more work with peers outside of class, use of the Tablet PC in learning the material, enhanced ability of students to complete assignments in a timely manner, greater ability on the part of the students to follow the instructor's lecture, greater understanding on the part of the students of how to work and learn in groups, all participants in the classroom working effectively with each other, and active class participation.

Technology Integration

Tablet PC technology is used to facilitate cooperative learning, synchronous and asynchronous interaction around learning, critical thinking, and just-in-time access to knowledge resources to accelerate learning, add depth to learning, educate students in teamwork, and stimulate innovative approaches to problem solving. Faculty members use technology to teach students face-to-face, and to provide individualized instruction through Web tutorials and a combination of face-to-face and online. The software currently used is Ubiquitous Presenter (UP) and One Note to deliver lectures, explain problems or answer students' questions. UP also allows saving all the lectures and instructor's notes for later review by students who missed a class or want to study for tests. Yugma is used to demonstrate any software that faculty want students to see and understand how to use such as Multisim and LabVIEW. Thanks to the Tablet PC, faculty can carry out these demonstrations whether the students are on- or off-campus. Faculty uses Yahoo Messenger to talk and listen at the same time that a demo or explanation is being conducted; they also use the computer-based Instructional Resources provided by book publishers.

Conclusion

The use of the Tablet PC has proven very beneficial to students' learning and development of other abilities such as teamwork skills, communication skills and research skills. Students' performance increased as a result of the use of the Tablet PC in select classes at The National Hispanic University and San Jose State University. The appropriate software for the Tablet PC and the willingness of faculty to adopt the Tablet PC technology in their teaching is another leap in improving the teaching/learning process and also to reduce the divide gap especially among minority students.

Acknowledgements

This project was possible thanks to a HP Technology for Teaching grant awarded in 2007. Thanks to professors from the computer science department and math/science department from The National Hispanic University for their contributions in testing this project in their physics, chemistry and computer programming classes. Thanks also to NHU's administrators and IT department for their support throughout this project.

References

- ¹ Seymour, E., Wiese, D. J., Hunter, A., & Daffinrud, S. (2000). Creating a Better Mousetrap: On-line Student Assessment of their Learning Gains. Paper originally presented to the National Meetings of the American Chemical Society Symposium, "Using Real-World Questions to Promote Active Learning," San Francisco, March 27, 2000. Available: <http://www.aacu-edu.org/SENCER/pdfs/Mousetrap.pdf>