Weitz, R. R., Wachsmuth, B. & Mirliss, D. (2006). The Tablet PC For Faculty: A Pilot Project. *Educational Technology & Society*, 9 (2), 68-83.

The Tablet PC For Faculty: A Pilot Project

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ABSTRACT

This paper describes a pilot project with the purpose of evaluating the usefulness of tablet PCs for university professors. The focus is on the value of tablets primarily with respect to teaching and learning (and not for research or administrative work). Sixty-four professors, distributed across the various schools of a university, were provided with tablet PCs and were trained in their use. A survey was distributed to the participants at the end of the semester. There were 59 respondents, and of these 45 used the tablet in at least one of their classes. This paper describes the pilot project and the survey results. We observed that a) only a fraction of faculty are motivated to use tablet technology: roughly a third of faculty expressed an interest in replacing their notebook computer with a tablet computer and b) generally, participating faculty did indeed use tablet functionality in their classes and were convinced that this use resulted in a meaningful impact on teaching and learning.

Keywords

Tablet PC, Instructional technology, Higher education, Electronic whiteboard

Introduction

A tablet PC may be defined as “a type of notebook computer that has an LCD screen on which the user can write using a special-purpose pen, or *stylus*. The handwriting is digitized and can be converted to standard text through handwriting recognition, or it can remain as handwritten text.” (Webopedia 2004). There are two basic versions of tablet PCs, one that includes a keyboard and one that doesn’t. The keyboard variety doubles as a standard notebook computer, with the screen swiveling and being laid flat over the keyboard when utilized in tablet mode. The model without a keyboard, also termed a “slate”, sacrifices functionality for lighter weight and smaller size. Generally speaking, tablet PCs command prices some several hundred dollars higher than comparably equipped (in terms of processing power, RAM, hard drive capacity, etc.) standard notebooks. Targeted commercial markets for tablet PCs include healthcare, insurance, sales force automation, finance and manufacturing/design (Himmelsbach 2004, Niccolai 2003).

Several recent projects have focused on *student* usage of tablet PCs. On the elementary school level, Kravcik et al. (2004) describe the use of a tablet PC in the design of a system enabling “virtual field trips” by elementary school students. Crossland et al. (2000) provided tablet PCs to students in their distance tutoring system for mathematics. Cooper and Brna (2001) discuss the use of tablet PCs in their project that “allows children of age 5-6 years to co-construct a multi-frame cartoon to help story-writing with the help of an empathic agent.”

At the higher education level, Scheele et al. (2004) discuss a lecture environment in which students are equipped with a variety of mobile, wireless devices, including tablet PCs. McFall and Dahm (2004) evaluate a prototype electronic textbook application running on the tablet PC platform. Yamasaki and Inami (2004) describe a tablet PC-based system for helping students acquire the skills and knowledge for proper handwriting of Japanese characters.

The use of tablet PCs, principally by students, in higher education was tested during the summer and fall of 2002 by Microsoft and its partners through their "Rapid Adoption Program." Three universities- MIT, Bentley College (in Waltham, Massachusetts), and the University of Texas at Austin - were chosen to participate in this program (Foster 2003, Microsoft 2002, ITRC 2002, Bentley College 2003, Condon 2003).

Though details have not been released, Bentley College's initial pilot, which ended in May 2003, indicated positive responses to the use of the tablets and Bentley reported plans to extend their pilot through July 2004.

MIT utilized tablet PCs during its participation in the annual International Design Competition. Tablets (connected via wireless networking) allowed students to write math equations as well as to sketch, modify and share their designs easily. This approach was a significant improvement over paper-based or non-tablet technology.

The participants of the pilot at the University of Texas at Austin were students in The School of Architecture, who used the tablet in four courses. In one they collected field data using the tablets, and in the others they reported positive results when note-taking in class and using the tablets with design and drawing software. Users reported that the tablet's pen allowed a more natural interaction with the software than that available via standard computers. (However, though the pen allowed a more natural interaction with the electronic design environment, students complained that it lacked the pressure sensitivity required of a drawing tool.) Participants also reported that the tablet allowed greater mobility and creativity. They could use the tablet in almost any setting, enabling users to spontaneously create designs that can then be refined at a later time.

It should be noted that users have also commented on some perceived shortcomings in tablets. In addition to the lack of pressure sensitivity mentioned above, these deficiencies include short battery life and excessive weight (Asay, 2002), the premium cost (Bentley College 2003), and difficulty in seeing the screens when outdoors in bright light (ITRC 2002).

The aforementioned projects, reasonably enough, have been student-centered, with either explicit or implicit constructivist philosophies (Duffy and Jonassen 1992, Wilson 1996). However, the functionality of tablet PCs provide for some potentially valuable opportunities for *faculty* in their role as educators in a lecture style format.

For example, tablets may be used in the classroom (along with a projector) as an electronic blackboard. Supply and demand curves, drawings of the human body, musical scores, electronic circuit diagrams, mathematical expressions (e.g., summation and integral signs), along with text (in any alphabet) may be captured and displayed. The tablet allows for multiple colors and widths of "ink", and a virtually unlimited number of pages over which to write without erasing. Further, class notes created in this way may be saved and posted to the Web, where students can retrieve them and view them using freely available software (tablets not required). There are instructional opportunities outside of the classroom as well. For example, tablets have the potential to be used for electronic grading; assignments may be emailed to faculty or dropped off in digital drop boxes whereupon faculty may write their comments on the work and return it to the students the same way.

There have been some initial reports of faculty use of tablets in the classroom. Wassgren and Krousgrill (2003) used a tablet-based system to record their in-class, pen annotated, PowerPoint based lectures for (later) storage and dissemination via the Web. Condon (2003) summarized their findings as follows: "(1) taking advantage of the Tablet PC's Journal software, using partially prepared slides and annotating them in class, was the most effective teaching style; (2) posting the recorded lectures on the web had no effect on attendance; (3) the students liked the clearer diagrams with colors and highlighting; (4) class preparation took a little longer; (5) setup and breakdown time for lecture delivery was only 2 to 5 minutes; and (6) few students viewed the online lectures if they had come to class". Anderson (2004) describes the use of a similar system. In this application, one faculty member, responding to the increased functionality said, "Being able to diagram and spontaneously work examples instead of having to use a pre-scripted PowerPoint slide deck—felt like teaching a real class."

Logic, and these initial studies indicate that tablet PCs have something to offer faculty in academia. The purpose of the pilot project described here was to test and evaluate faculty applications of tablet PCs apropos their contribution to teaching and learning. Put another way, how would real faculty teaching actual classes use tablets, and how would they evaluate the utility of doing so? The pilot would help us answer such questions as:

- How do faculty perceive the value of tablet PCs with regard to teaching and learning?
- Are tablet PCs actually useful for teaching and learning?
- If so, how valuable are they and in what ways?
- What challenges/pitfalls are there in using this technology for teaching and learning?

Tablets cost from $200 - $400 more than comparable notebooks (Einhorn 2004). As faculty at Seton Hall University, where this study was conducted, were already provided with notebook computers, perhaps the overarching question to be resolved by the study was, do the added benefits of tablet technology indicate that all or some faculty should move from the notebook platform to the tablet?

Background

Seton Hall University (SHU) is a research and teaching-oriented university with some 10,000 graduate and undergraduate students. It has had a major focus on instructional technology for almost a decade. In the fall of 1995 SHU instituted a pilot project for evaluating a notebook/mobile computing environment (Weitz 1997); this pilot project resulted in notebook computers being distributed to all full-time students and faculty, and the implementation of an infrastructure – technical, administrative and instructional – to support them. In 2003, for example, more than 2,000 notebooks were distributed to freshmen, transfer students, faculty, and administrators, and almost 1,000 notebooks of sophomore students were "refreshed". (Notebooks are replaced with current models every two years.) The campus has extensive wireless coverage, Internet2 connectivity, active use of standard course management software, and a center supporting numerous faculty instructional technology initiatives. SHU has ranked among the top 15 most wired universities in the United States in *Yahoo! Internet Life's* survey of technology on college campuses.

The university formed a Teaching, Learning and Technology Roundtable (TLTR) after participating in the American Association for Higher Education (AAHE) Summer Institute in 1995. A TLTR has been defined as "a diverse group that meets regularly, considers issues, and (usually) provides advice to the chief academic office, other leaders, and many constituencies" (TLT Group, n.d.).

The TLTR at SHU consists of the following action teams:

- Administrative Computing
- Best Practices
- Emerging Technologies
- Financial Resources Development
- Steering Committee
- Technology Assessment

The Emerging Technologies team, composed of faculty and administrators, is charged with 1) staying informed of national trends in technology integration in higher education and 2) communicating its findings to the university community. The team submits a yearly report with general recommendations and in early 2003 it was recommended that the university explore the use of tablet PC technology by faculty and, to a lesser extent, by administration and staff. To this end, a small "pre-pilot" study was approved.

The "Pre-Pilot" Study – Fall 2003

While open to exploiting new technologies for teaching and learning, SHU is, at the same time, naturally cautious in this type of endeavor. With this in mind, prior to authorizing a full pilot study, in the spring of 2003 a small (16 participant) "pre-pilot" was begun. Faculty, staff, and administrators were invited to participate in this small experiment with tablet computing by filling out a simple form and returning it via email. They were asked, in particular, to complete the following two statements.

- I think tablet PCs are more useful than regular laptops because:
- I would like to test my tablet PC for the following purpose(s):

Fifty-eight valid applications were received from all areas of the university. A subcommittee of the Emerging Technology group met to evaluate the ideas presented and to award machines to the most promising applications. Generally speaking the subcommittee was looking for applicants who were best able to describe the advantages of a tablet PC over a regular laptop, and who had the most interesting suggestions for its use. The kind of things looked upon favorably by the committee included:

- Demonstration of real pedagogical payoff; for example, the need to compose formulas, write in foreign alphabets, draw diagrams, etc.
- Indication that the faculty member had thought about electronic storage and retrieval of tablet-created documents.

- Ideas more significant than mundane usage; e.g., use of the tablet for note-taking at meetings or a preference for a lighter-weight platform than the current notebook.

The faculty responses are available at http://www.cs.shu.edu/tabletpc/2003-ideas.html. They have been summarized by Condon (2003) as follows:

- Several faculty proposed using the tablets in place of writing on the chalkboard or on overheads. One professor who alternates between using a laptop and the chalkboard in lectures has had a problem getting chalk dust all over the computer keyboard. He hopes switching to a Tablet PC might allow him to eliminate the use of the chalkboard altogether.
- An English professor envisioned projecting a literary passage on the screen and being able to make notes on the printed material.
- Several professors who teach finance, statistics, and physics look forward to being able to write equations quickly during lectures without resorting to the chalkboard and easily answer e-mailed questions with appropriate equations.
- A professor of clinical medicine was enthusiastic about teaching anatomy and physiology by annotating anatomical slides.
- A professor who will be teaching freshmen to use Excel and Access as management information systems would like to be able to project the operating software while answering student questions by drawing on the screen.
- The biology department plans to issue the Tablet PC to a student who will compare the use of the Tablet PC to her standard laboratory notebook to see which is more efficient as a way to record research.
- One physics professor sees the Tablet PC as a way to seamlessly incorporate Excel, Java, web animations, and *Interactive Physics* simulations in his lectures.
- A professor who teaches computer graphics normally draws sketches on the chalkboard and then teaches how to implement the design in the software. If he could draw the sketch on the Tablet PC, he could make the sketch electronically available to his students outside of class.

Ideally the committee hoped for a distribution across schools and departments, with some administrative use. Fortunately the applications broke down naturally along these lines.

Sixteen applicants were approved that represented a distribution across schools and departments, with some administrative use. The sixteen participants self-rated their experience-comfort level with computers as follows: Novice/Beginner: 2**,** Intermediate: 6 and Advanced/Expert: 8**.**

Participants responded to detailed surveys prior to the start of the semester and at its end. The surveys indicated that the tablets were used productively, both inside and outside the classroom, resulting in a positive impact on teaching and learning. A working paper detailing the pre-pilot and its evaluation are available from the authors. With the encouraging results of the pre-pilot in mind a full pilot program was initiated for the fall of 2004. Given financial and technical-support constraints, the pilot would be limited to about 60 participants.

The Pilot Study – Fall 2004

As stated previously, SHU provides all faculty and undergraduate students with notebook computers and these computers are replaced with new models every two years. In the spring of 2004 faculty eligible for notebook replacement were asked to express one of the following preferences: they could 1) exchange their current notebook computer for the new model notebook, 2) keep their current notebook for another year, or 3) apply for a tablet computer. If the number of faculty requesting tablets exceeded the maximum, about 60, an application procedure would be established as it had been for the pre-pilot.

The specifications of the two machines were made available to the faculty, both via TLTR events and via the Web. Aside from tablet functionality, the essential differences were that the tablet had a smaller screen than the notebook, and an external CD/DVD-RW drive as opposed to an internal one for the notebook.

Faculty responses are provided in table 1.

Table 1: Faculty Preferences Regarding Notebook Computer Replacement

Option	Number of Faculty	Percentage of Faculty
Replace with the new model notebook	113	51.36%
Keep current notebook for an extra year	43	19.55%
Apply for a tablet PC	64	29.09%
Total	220	

This data in itself is of interest. First, approximately 20% preferred keeping their two year-old computer as opposed to upgrading. We surmise that the effort of transferring files and settings (even with the aid of technical staff) is not worth the bother to these individuals. Further, it seems that (only) approximately 30% of faculty eligible for hardware replacement felt that a tablet computer would be a better choice than a standard notebook, or a sufficiently better choice to warrant the effort of learning how to use the technology. This figure provides a measure of the perception faculty have of the benefits of tablet technology. We shall return to this data later in the results section. In any case, as all faculty interested in a tablet could be accommodated, no further application process for the pilot was required.

Pilot Participants

The pilot, with 64 faculty members participating, took place during the fall semester of 2004. A survey was distributed at the end of the semester to participating faculty, and 59 responses were obtained. Of the 59 respondents, 45 utilized the special functionality of their tablet for teaching and learning in at least one of their classes.

Table 2 provides the distribution across disciplines of respondents to the survey.

Table 2: Distribution of Tablet PCs for Pilot

School	All Survey Respondents	Respondents Who Used Tablet Functionality for Teaching/ Learning
Arts and Sciences	35	25
Business	7	5
Education	5	5
Nursing	6	5
Graduate Medical Education	3	3
Theology	1	1
Library	2	1
Total	59	45

Applicants were asked to self-rate themselves in terms of their experience-comfort level with computers. Table 3 summarizes the responses.

Table 3: Participant's Self-Rated Experience/Comfort Level with Computers

Experience/Comfort Level With Computers	All Respondents	Percent	Respondents Who Used Tablet Functionality for Teaching/ Learning in At Least One Class	Percent
Novice/Beginner	8	13.6%	5	11.1%
Intermediate	30	50.8%	20	44.4%
Advanced/Expert	21	35.6%	20	44.4%
Total	59	100.0%	45	100.0%

We see no particular pattern among faculty who did not use tablet functionality in each least one course during the semester. The reasons faculty gave for non-use are compiled below, in table 4.

Table 4: Reasons Tablet Functionality Not Used For Teaching and Learning

Reason	Number of Faculty
Sabbatical/Not Teaching	4
Received Tablet Too Late	2
Technical Problems	1
Just Didn't Use	6
Was a Mistake to Get Tablet	1
Total	14

We see that four faculty simply were not teaching during the semester, and two received the tablet "too late" to incorporate it into their teaching. The individual with technical problems indicated that the tablet was "out for repairs" for most of the semester. This leaves seven who didn't use tablet functionality other than for some exogenous factor. The six faculty who "just didn't use" the tablet functionality indicated that due to competing work and time pressures they never got around to learning how to use the tablet or how to integrate it into their course(s). The last individual simply indicated that, in retrospect he didn't need or want tablet functionality.

For the remainder of this paper, except where noted otherwise, we utilize data only from the 45 respondents who utilized tablet functionality in the service of teaching and learning in at least one of their classes.

In-Class Use of Tablets

This section discusses survey results related to faculty's in-class use of the tablets.

Survey Data

Table 5 summarizes faculty responses with respect to the *frequency of use* of tablet applications. Table 6 focuses on the respondent's assessment of the *impact on teaching and learning* of each application used. We recognize that these are different measures (and, in particular, that a low frequency of usage of a particular application does not necessarily mean a low impact of that application).

The first column of table 5 provides a range of in-class tablet applications. The next five columns indicate faculty responses regarding the frequency with which they used each application. So, for example, nine faculty (20% of respondents) indicated that they used their tablet for writing mathematics in every or almost every class. Three (6.67%) frequently did so. The "total" column indicates the number of respondents for each application.

Table 5: Frequency of use of tablet functionality: in-class applications

For this course, please indicate below how frequently you used the unique functionality of the tablet PC (e.g. handwriting/drawing) in class as part of the lecture (e.g. in conjunction with a projector) for each of the applications listed.

In-class Applications	Always/Almost Always	Frequently	Occasionally	Never/Not Applicable	Total
Writing Mathematics	9	3	8	25	45
	20.00%	6.67%	17.78%	55.56%	
Writing non-English text; e.g., Hebrew, Russian, Greek (in a non-mathematical context)	2	0	2	41	45
	4.44%	0.00%	4.44%	91.11%	
Drawing diagrams, charts, and/or graphs	8	4	19	14	45
	17.78%	8.89%	42.22%	31.11%	
Correcting assignments/ projects (e.g. writing on documents during in-class demonstration)	6	6	10	23	45
	13.33%	13.33%	22.22%	51.11%	
Using the handwriting functionality and a new (blank) Windows Journal or Word file to create lecture notes. (That is, using the tablet in-class as	11	7	10	15	43
	25.58%	16.28%	23.26%	34.88%	

an electronic whiteboard.)					
Using the handwriting functionality to draw or write over prepared (already has content) Windows Journal, PowerPoint, Word or Excel files.	8	7	16	14	45
	17.78%	15.56%	35.56%	31.11%	
Electronically distributing in-class, tablet-created handouts/lecture notes to students.	9	5	7	23	44
	20.45%	11.36%	15.91%	52.27%	

(Note that the "always" and "almost always categories", and the "never" and "not applicable" categories were separate responses in the questionnaires. They have been collapsed into single categories here for clarity.)

Respondents' impressions of the impact of *their* use of each application are summarized in table 6. (Note that the categories in the first column have been abbreviated in the interest of saving space.) Ten faculty felt that their use of the tablet for writing mathematics had a "very positive" impact on teaching and learning. Percentages in this table are based on faculty who used the application at least occasionally. So, for example, these ten faculty make up 50.00% of all (20) respondents who used their tablet for writing mathematics in class at least occasionally. If faculty did not use an application at all, they were (of course) not able to estimate the impact of their use of that application; these responses are captured in the second-to-last column.

Table 6: Perceived impact of tablet functionality: in-class applications
(Percentages based on respondents who used the application at least occasionally.)

*Now please consider the in-class applications listed above *that you have used at least occasionally*. Please rate below the impact you feel YOUR use of that application has had on teaching and learning in this class.*

In-class applications	**very positive**	**positive**	**neutral/no added value**	**negative**	**very negative**	**don't know/no opinion**	**did not use at least occasionally**	**total**
Writing Mathematics	10	8	1	0	0	1	25	45
	50.00%	40.00%	5.00%	0.00%	0.00%	5.00%		
Writing non-English text	3	0	0	0	0	1	41	45
	75.00%	0.00%	0.00%	0.00%	0.00%	25.00%		
Drawing diagrams, charts, and/or graphs	11	17	1	1	0	0	14	44
	36.67%	56.67%	3.33%	3.33%	0.00%	0.00%		
Correcting assign'ts/projects	7	6	5	0	0	4	23	45
	31.82%	27.27%	22.73%	0.00%	0.00%	18.18%		
Using the handwriting functionality to create lecture notes.	10	13	2	0	0	3	15	43
	35.71%	46.43%	7.14%	0.00%	0.00%	10.71%		
Using the handwriting functionality to draw or write over prepared content.	12	11	6	0	0	2	14	45
	38.71%	35.48%	19.35%	0.00%	0.00%	6.45%		
Electronically distributing in-class, tablet-created handouts/lecture notes to students.	9	5	4	0	0	3	23	44
	42.86%	23.81%	19.05%	0.00%	0.00%	14.29%		

Discussion

Figure 1 provides a summary of the usage of in-class applications and the perceived impact of that usage. We see, for example, that 45 faculty responded to the question regarding the usage of the tablet for writing mathematics in the classroom. Twenty of these respondents indicated that they used this application at least occasionally. Eighteen of these 20 rated the impact of their use of this application as positive or very positive.

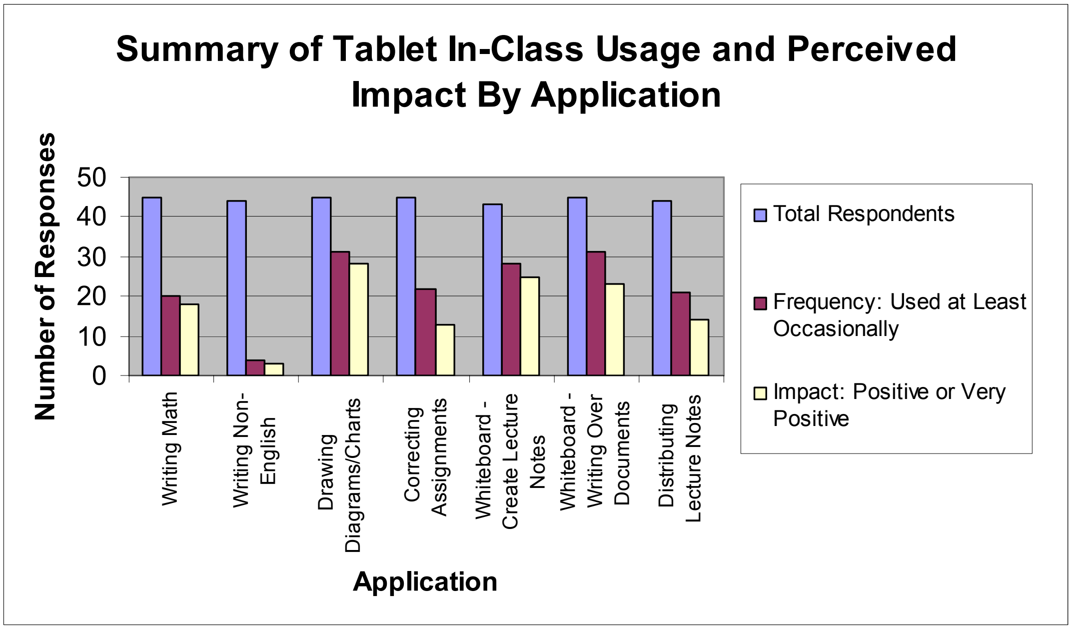

Figure 1: Summary of in-class results

The number of faculty who used an application on at least an occasional basis provides a snapshot of the extent of diffusion of that application. We see that approximately two-thirds of the responding faculty used their tablets as a whiteboard – creating notes from scratch (65.12%) and writing over materials prepared before class (68.89%). Not surprisingly, faculty used the tablets in domains where the drawing functionality is most useful: writing mathematics (44.44%) and drawing diagrams, charts and graphs (68.89%). Almost half of respondents (48.89%) used the tablets to correct assignments/projects as an in-class demonstration and almost half (47.73%) electronically distributed in-class, tablet-created materials to their students. Only four faculty used the tablet for writing non-English characters, though this small number reflects the few participants in the study likely to need this functionality.

Faculty felt positively about the impact on teaching and learning of the applications they used. Approximately 90% felt that their use of a tablet for writing mathematics and drawing diagrams, charts and/or graphs had a positive or very positive impact. Some 80% responded that the impact of using the tablet as a whiteboard without prepared materials, was positive or very positive. Approximately 75% thought using the tablet to write over prepared material had a positive or very positive impact. Over 60% felt that using the tablet to correct assignments/projects as part of in-class demonstrations had a positive or very positive impact. Likewise over 60% of faculty who distributing the notes they created in-class felt that doing so had a positive or very positive impact. Three of the four faculty who used their tablet to write non-English text felt that this application had a positive or very positive impact.

Out-of-Class Use of Tablets

This section discusses survey results related to faculty's use of the tablets outside of the classroom.

Survey Data

Again, we separately analyzed frequency of use and perceived impact data. Table 7 summarizes faculty responses with respect to the frequency of use of tablet applications outside of the classroom. Table 8 focuses on the respondent's assessment of the impact on teaching and learning of each of these applications.

The first column of table 7 specifies the outside-of-classroom applications. The next five columns indicate faculty responses regarding the frequency with which they used each application.

So, for example, eight faculty (17.78% of respondents) indicated that they used their tablet for grading assignments and/or projects for every or almost every class. Five (11.11%) frequently did so. The "total" column indicates the number of respondents for each application.

Table 7: Frequency of use of tablet functionality: outside-of-class applications

Outside-of-class applications	**always/almost always**	**frequently**	**occasionally**	**never/not applicable**	**total**
Using the handwriting functionality of your tablet to grade assignments/projects.	8	5	13	19	45
	17.78%	11.11%	28.89%	42.22%	
Using the handwriting functionality of your tablet to prepare handouts/lecture notes before class.	5	7	13	20	45
	11.11%	15.56%	28.89%	44.44%	
Electronically distributing handouts/lecture notes (created outside of class) to students.	8	4	12	21	45
	17.78%	8.89%	26.67%	46.67%	

*Table 8***:** Perceived impact of tablet functionality: outside-of-class applications
(Percentages based on respondents who used the application at least occasionally.)

Outside-of-class applications	**very positive**	**positive**	**neutral/no added value**	**negative**	**very negative**	**don't know/ no opinion**	**did not use at least occasionally**	**total**
Using handwriting functionality to grade	8	12	2	2	0	2	19	45
	30.77%	46.15%	7.69%	7.69%	0.00%	7.69%		
Using handwriting functionality to prepare handouts/ lecture notes	9	10	2	0	0	4	20	45
	36.00%	40.00%	8.00%	0.00%	0.00%	16.00%		
Electronically distributing handouts/ lecture notes	9	10	2	0	0	3	21	45
	37.50%	41.67%	8.33%	0.00%	0.00%	12.50%		

Discussion

Figure 2 provides a summary of the usage of applications outside the classroom and the perceived impact of that usage. Forty-five faculty responded to each question. We see, for example, that 26 indicated that they used the handwriting functionality of their tablet for grading assignments/projects outside of class; of these 26, 20 rated the impact of their use of this application as positive or very positive.

This data is fairly consistent across applications: a little more than half of the respondents used each outside-of-class application, and about three-quarters of those who used an application felt that that usage resulted in a positive or very positive impact.

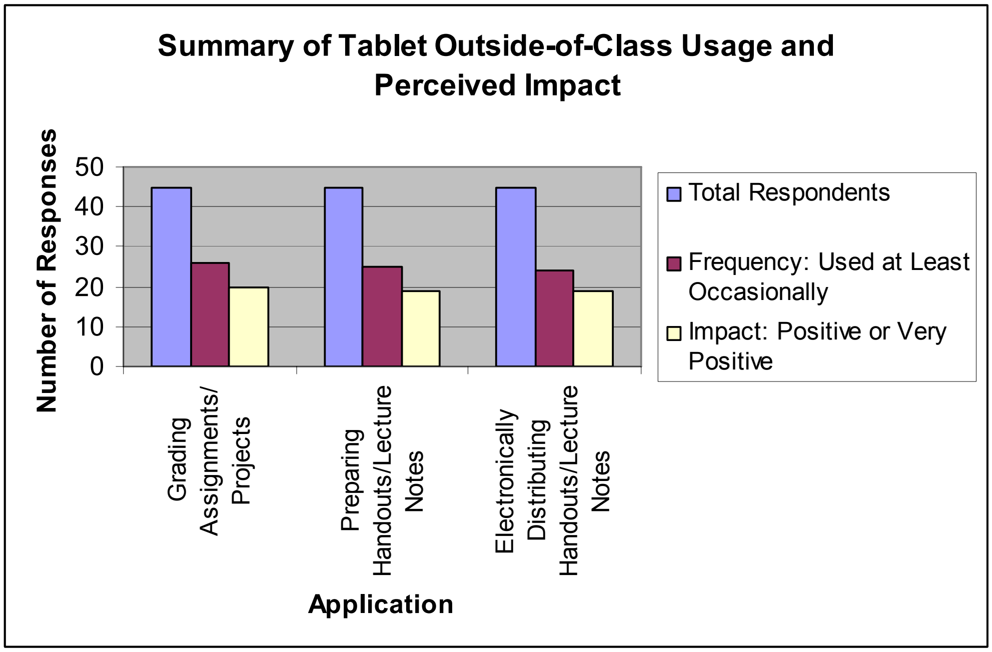

Figure 2: Summary of outside-of-class results

Qualitative Responses

We also polled participating faculty with open-ended questions. When asked to, "Indicate what seems to be the most valuable attributes of the tablet for teaching and learning in this course," faculty responded as follows.

- Ability to write and save lecture notes in class, especially involving graphs and equations
- Ability to write on my prepared documents, especially PowerPoint slides! (Gave students a much better sense of what I was describing.)
- Because I teach courses about students with special needs, the entire instrument serves as a model for what can be done to enhance opportunities for learning.
- Being able to create lecture notes inside of class and being able to distribute them electronically
- Being able to write over prepared lecture tools like PowerPoint.
- Distributing solutions to problem sets and lecture notes.
- Drawing diagrams.
- Easier to grade papers than track changes [using standard MS Word] which sometimes does not leave space for me to type in the corrections or comments I want to make
- Flexibility; replaces chalk and allows an ongoing discussion without the usual chalkboard distractions.
- For enhancing lecture notes during class.
- Grading papers -- the light weight of the tablet and my ability to download papers into Word and grade using ink annotation lightens my load, literally and figuratively. Hand writing my comments (including drawing circles, arrows, etc.) makes my grading go faster.
- Hand grading papers.
- Hand writing for non-English.
- Hand writing for grading.
- I can truly write equations in little time. Easy to send to Blackboard and student can pay more attention in class.
- I used the handwriting/annotating feature frequently in lectures using PowerPoint. However, this often crashed, which diminished its usefulness. Still, I found the ability to annotate very helpful and the students also seemed to feel it was helpful.
- If it worked well all the time - I would like the writing ability on my PowerPoint presentations and the ability to compose new slides - technical problems have made this difficult.
- It is great not to have to turn away from my students to write, and it's nice to have the many color and pen options on digital ink, which I've used to create helpful diagrams (without carrying a bag of colored markers to class).
- It is light and facilitates instruction.

- [I] liked the handwriting component.
- Posting in-class lecture on line.
- Teaching statistics -- writing on the tablet instead of on the whiteboard enables me to face the students while teaching. Also, it's quicker as there's no need to erase. I just pull up a new page. Another benefit is that I'm not blocking what the students are looking at.
- The ability to draw graphs freehand and to add content to prepared materials will be a useful attribute. I also plan to make digital recordings of lecture material for in-class and online deliver for next semester's classes.
- The ability to write and edit papers while on line.
- The portability, added features of handwriting to emphasize points in the moment.
- The use of the tablet is invaluable for grading papers and providing timely feedback to students.
- This is a great tool, to be able to write mathematics on the computer, save it and send it to my students. Using Microsoft Equation [Editor] or any of the other software used to type mathematics, is very time consuming and not something I would use on a daily basis. Being able to write solutions to problems using the Tablet PC has enhanced the way I can use the computer in the classroom.
- Using it as a white-board.
- Using note pad
- Visual learners benefit by seeing instructor create real-time (diagrams, charts, etc.)
- Writing and displaying Greek and Hebrew and distributing transcripts of class work.
- Writing and displaying that writing directly while I FACE the class
- Writing on my already prepped PowerPoints so that I don't have to futz with the projector-in-front-of-the-whiteboard.
- Writing on PowerPoints.
- Writing on the screen - I can get back to my chalkboard!!

It appears that faculty have used tablet functionality as expected, and generally have a positive response.

We asked, "What difficulties, if any, did you experience in using the tablet?" Responses are summarized below in table 9.

Table 9: Difficulties Experienced by Participants with the Tablet

Difficulty Experienced	**No. Respondents**
System hangs/need to reboot	11
Oversensitive mouse -- cursor jumping associated with mouse/touchpad	7
Problems with the external DVD drive	7
Problems with wireless connectivity	3
Screen orientation	2
Don't like external DVD drive	2
System instability/crashing when annotating in PowerPoint	2
Battery life	1
Problems with network connectivity	1
Problem with USB port	1
Insufficient hard drive capacity	1

The difficulties with the external DVD drive appear to be specific to this particular model. The screen orientation difficulty refers to the fact that the image projected on the LCD projectors in the classroom was, by default, inverted; this meant that the instructor had to rotate the image on the tablet 180 degrees – not a difficult process, but one that requires several steps – *and* turn the tablet upside down. We don't believe the connectivity issues are distinct from those found using the standard notebooks at SHU. On the other hand, the problems associated with the cursor skipping, and with the system hanging/crashing are in our view more troubling. Certainly encountering these problems during a lecture can be harmful to continuity and focus.

We were interested in overall issues relating to the performance of the tablet. We asked the participants to rate the hardware and technical aspects of the tablet along the dimensions outlined in table 10 below.

Table 10: Faculty Satisfaction with Hardware and Technical Aspects of the Tablet

	very satisfied or satisfied	neutral	unsatisfied or very unsatisfied	not applicable	total
memory/hard drive/ processing speed	27	11	7	0	45
	60.00%	24.44%	15.56%	0.00%	
size of keyboard	35	3	7	0	45
	77.78%	6.67%	15.56%	0.00%	
size of monitor	34	2	9	0	45
	75.56%	4.44%	20.00%	0.00%	
external DVD drive	7	6	28	4	45
	15.56%	13.33%	62.22%	8.89%	
weight/portability	41	4	0	0	45
	91.11%	8.89%	0.00%	0.00%	
wireless access	33	7	4	1	45
	73.33%	15.56%	8.89%	2.22%	
battery life	31	6	7	1	45
	68.89%	13.33%	15.56%	2.22%	
speech recognition	5	7	0	33	45
	11.11%	15.56%	0.00%	73.33%	
digital ink functionality (handwriting)	34	7	3	0	44
	77.27%	15.91%	6.82%	0.00%	
converting handwriting to text	23	10	6	6	45
	51.11%	22.22%	13.33%	13.33%	

Dissatisfaction with the external drive shows up here too, and in fact seems to be the only attribute of the tablet about which there was significant unhappiness. Some 90% of respondents seemed pleased with the weight/portability characteristics of the tablet. We suspect this is partly a function of the fact that the standard notebook provided faculty is at the heavy end of the portable computer spectrum. Roughly 75% of respondents were satisfied or very satisfied with the size of the keyboard, size of the monitor, wireless access and digital ink functionality. Converting handwriting to text seems to get a more mixed picture with 23 respondents (roughly 50%) satisfied or very satisfied, and six unsatisfied or very unsatisfied, and six who didn't use this functionality. Only a few faculty used the speech recognition capability.

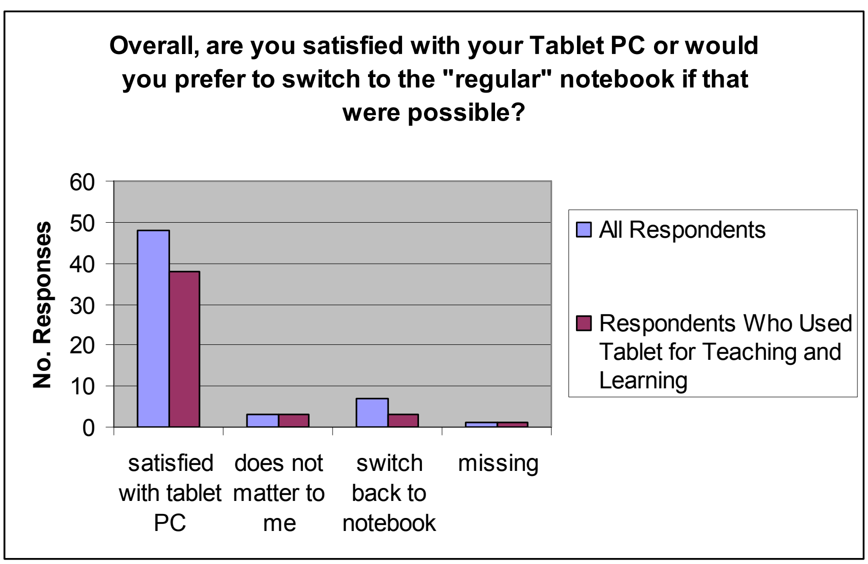

Figure 3: Tablet vs. Notebook Preferences

Our view is that these results are very positive. This is reinforced by the results outlined in figure 3; it appears that participants overwhelming preferred their tablet to a standard note book.

We see, for example, that some 85% of those who used tablet computing in at least one of their classes would prefer to keep their tablet as opposed to returning to a standard notebook. It is worth noting that three respondents of those who actually used tablet technology preferred to switch back to a notebook. These individuals cited the technical problems noted earlier: failure of the external drive, repeated occurrences of the system hanging, and network difficulties. With regard to all respondents, some 80% would stay with a tablet and seven would prefer to go back to the standard notebook. Of these additional four who preferred a standard notebook, one was the respondent whose tablet was "out for repair", another indicated that he never used the machine and that "it was a mistake" for him to request a tablet, the third simply didn't use it and the fourth was a novice user on sabbatical who got frustrated by problems with the external drive and a faulty printer cable.

We note that tablet PCs are more expensive than conventional notebook computers. Figure 4 below reproduces the question we posed to the participants that brings this fact into decision-making, and provides a summary of the responses.

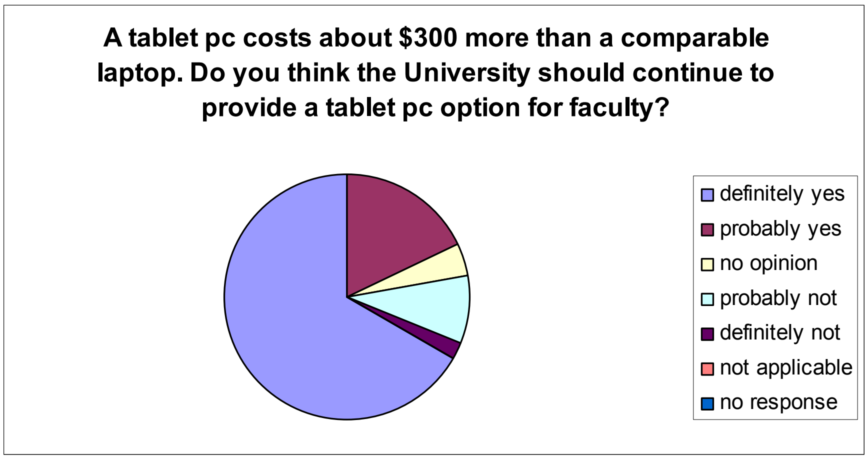

Figure 4: Preferences Regarding the Tablet Option Given the Additional Cost

Approximately 85% (38 out of 45) responded that SHU should definitely or probably continue to provide a tablet PC option to faculty. Five said the university probably or definitely should not, and two expressed no opinion.

The results in figure 5 highlight perhaps the most important issue here: the value, as perceived by faculty who used their tablet in at least one course, of this technology vis-à-vis teaching and learning.

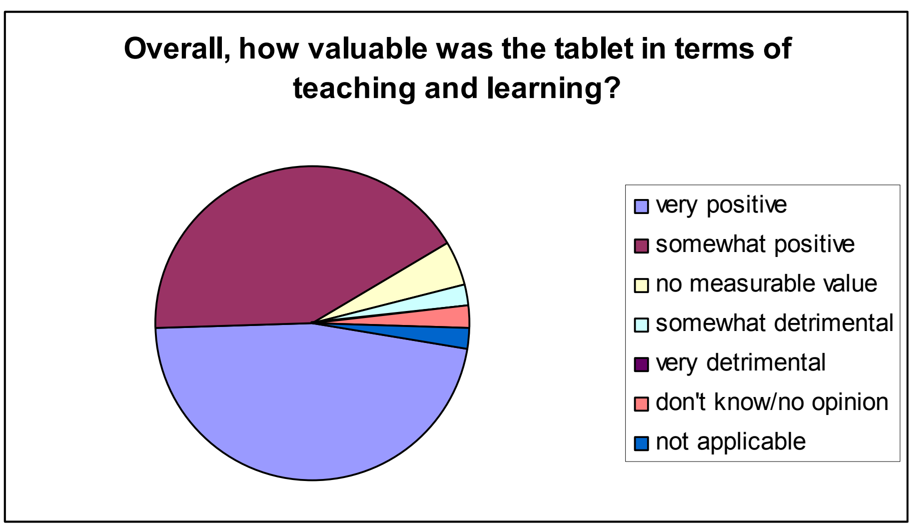

Figure 5: Value of tablet in terms of teaching and learning

Forty of the 45 faculty (approximately 90%) who used the tablet in at least one course responded that their use had a very or somewhat positive value with regard to teaching and learning. Two indicated that they observed no measurable impact, one indicated a "somewhat detrimental" effect. This individual cited system crashes and difficulties with cursor jumping associated with the mouse/touchpad.

Results

We feel that the results of this study may be summarized as follows.

There are tablet applications that will be used by some faculty with good results
Some faculty did use tablet functionality and their perception of the utility of that use vis-à-vis teaching and learning was positive. Aside from writing non-English characters, the applications considered here were used at least occasionally by 50% - 75% of respondents; further, on average 75% of these faculty rated the impact of this use as positive or very positive. The percentage of faculty who used the applications considered here *at least frequently* (as opposed to at least occasionally), ranged from 25% - 40%.

The tablet applications actually used by faculty are those predicted.
We see a good correspondence between the expectations of faculty and their actual usage of tablet applications. Put another way, generally faculty were not disappointed; they were able to do what they planned on doing with the tablets.

Negative feelings seem to be most strongly associated with technical problems.
The strongly negative feelings regarding the tablet felt by a few of the participating faculty seemed to result from technical problems they experienced. In particular difficulties with the external DVD/CD drive, system instability and cursor jumping were noted. Our feeling is that these are surmountable difficulties, with better support and training, and are not particular associated with tablet technology.

Faculty who use tablets are generally pleased with the results and strongly prefer to continue using tablets.
We measured faculty satisfaction with tablet computing via several questions, including one that explicitly took into account (as much as was possible) the added cost of tablet technology. Faculty who used tablets were favorably disposed to their usage, felt that the impact of that usage was positive, wanted to continue using tablet technology, and felt all faculty at the university should have a tablet option.

The majority of faculty are not "demanding" tablets
We see that (only) 30% of the 220 faculty members at SHU eligible for notebook replacement in the fall of 2004 opted to try a tablet. Data for the fall of 2005 reflect an almost identical breakdown, with again about 30% of faculty selecting the tablet option. Of the 64 who received a tablet in the fall of 2004, 59 replied to our survey, and (only) 45 actually used their tablet in at least one class. Using this last figure, it seems that approximately one-quarter to one-third of faculty perceive tablets to be something beneficial for their usage.

Conclusions

> Despite well-intentioned efforts to limit class sizes at many colleges, the lecture remains in place as the primary teaching format. The economics of higher education are such that few institutions can afford to discard lecture courses altogether, however much a small seminar is preferred by students and faculty members alike. With only one paid teacher and a large roomful of tuition-paying students, how can you beat the numbers?
>
> In my view, this is not necessarily a bad thing.

Jay Parini
"The Well-Tempered Lecturer"
The Chronicle of Higher Education
Volume 50, Issue 19, Page B5
January 16, 2004

We believe the above results indicate that tablet technology for a faculty should be pursued for those faculties with an interest in an application for which the tablet is well-suited. In particular, it seems that those fields that require freestyle drawing of diagrams, pictures and charts, as well as fields requiring the use of mathematical symbols are good areas for the use of tablets. These fields include many areas in the sciences and the social sciences, including, for example, physics, biology, chemistry, psychology and economics.

We believe that the results are consistent and provide reliable pointers towards the usefulness of tablet computing for faculty at the university level. In academia as elsewhere, there are always technology leaders and followers. The ultimate goal here is not to force all faculty members to use a technology, but rather to provide individual faculty with the tools they believe will assist them in their educational mission.

With the results of this study in mind, Seton Hall University is pursuing tablet technology, both continuing the option for faculty (as mentioned previously) and equipping students in our honor programs with tablets, in the fall semester of 2005.

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