

Tablet PCs for Teaching

A Usability Study of the HP tc4200

By

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Project Overview

The focus of this project is to evaluate the usability of the HP Compaq tc4200 tablet PC as a teaching aide. This study is targeted towards professors who would like to enhance their teaching methods by using the tools provided by a tablet PC. However, this project does focus on some of the general flaws of the aforementioned tablet PC, so there is a potentially broader audience than just a professor.

The original objective of this study was to determine the positives and negatives of using a tablet PC to create, present, and modify a lecture, but in completing this objective the researcher's of this study also found many flaws that did not directly pertain to the original objective. For the sake of being completely thorough, we have addressed and attempted to correct all of the flaws associated with the tc4200 whether they are related to teaching or not.

The initial idea for this project came about when two of the researcher's in this study had a professor who was able to effectively use a tablet PC to enhance his lecturing capabilities. These specific lectures gave the two researchers key insights into the class material that may otherwise have been lost in translation. As this specific class focused on computer architecture, most of the material involved either diagrams or figures that did not always come across clearly when presented statically to the class. One simple explanation of this problem is when static slides are presented to students: the slides are often changed too quickly for the student's to assess them. When the professor took the time to draw the pictures freehand using a stylus and his tablet PC, the material was presented in much more manageable chunks allowing most of the students to absorb the information at a more reasonable pace. This positive experience gave us the motivation to find out whether using a tablet PC was a good fit for every professor. We wanted to discover the difficulties involved with using a tablet PC to teach so we could suggest improvements, but we also wanted to highlight the capabilities of the tablet PC so professors everywhere can realize the advantages of the tablet to themselves and their students.

Data Collection Overview

In order to be as thorough and methodical as possible in our approach to this study, we took some time designing a study that specifically addressed the major tasks involved in presenting a lecture and using a tablet PC in tablet form. It wasn't enough to analyze the tc4200 ourselves, as many biased and closed-loop opinions were sure to develop. Therefore, we decided upon a usability study involving as many outside participants as possible. The idea was that the more opinions we recorded, the better conclusions we could form based on recurring patterns in the use of a tablet PC.

For the data collection portion of the study, a volunteer participant would be handed a script that contained a list of tasks he or she would complete and the researcher would have no interaction with the participant aside from a general explanation of the project. However, before participants could begin the list of tasks, they were required to sign a participation consent form for legal purposes. The required tasks focused on the activities necessary to create a new slide in PowerPoint, set up the tablet PC for interaction with the class projector system, present an already prepared presentation, and then modify that presentation. We designed these tasks with the intention of mimicking the actions a professor would have to perform in order to create and present a lecture.

After completing all tasks outlined in the script, the participants were asked to complete a fifteen question anonymous survey and then submit the survey to the researchers after they had finished. In addition to the participant surveys, we also used simple forms that allowed us to record our observations on focused areas of

the experiment. By using these two methods of data collection, we hoped to obtain redundant data from the perspective of both the user and the observer. Of course, if there turned out to be disparities between what the participants and the observers thought of the presented tasks, that was another specific problem to address either in terms of the inadequacy of the study or of the simple differing opinions of what the participants thought of their own performance on the tasks and what the observers recorded regarding the participant's performance on the same tasks. The observers in this case were experts in the use of a tablet PC and thus had the specific domain knowledge necessary to notice difficulties the participants had in completing the experiment.

So as not to be limited by the memory of the observers of this study, we chose to get some hard data by using the two aforementioned forms of data collection: the participant survey and the researcher observation form. The surveys were our way of obtaining participant opinion on the usability of a tablet PC. More specifically, the survey gave each participant the chance to rate how difficult it was to complete each task outlined in the script on a scale from 1 to 4 with 1 being the least difficult and 4 being the most difficult. In addition to the simple rating scale, the participants were asked specific questions related to areas that we felt were problematic. For instance, participants were asked how difficult it was to locate the power button on the simple 1 to 4 scale, but as a follow-up question they were asked for the first place they looked for the power button. The follow-up questions were an attempt by the researchers to fine tune some ideas we had for design changes of the tc4200. The observation forms were for the researcher's to record their observations on the participant as the participant completed each of the listed tasks. Each observation form had questions very similar to that of the survey in order to maintain focus on the specific tasks, as well as for a comparison later on of the participant's opinions and the observer's opinions.

Materials used during data collection

The materials used for data collection in this experiment included a consent form, a script of a mock lecture, a survey, and an observations form. The consent form, the mock lecture script, the survey, and the observation form can be viewed in the Appendix section.

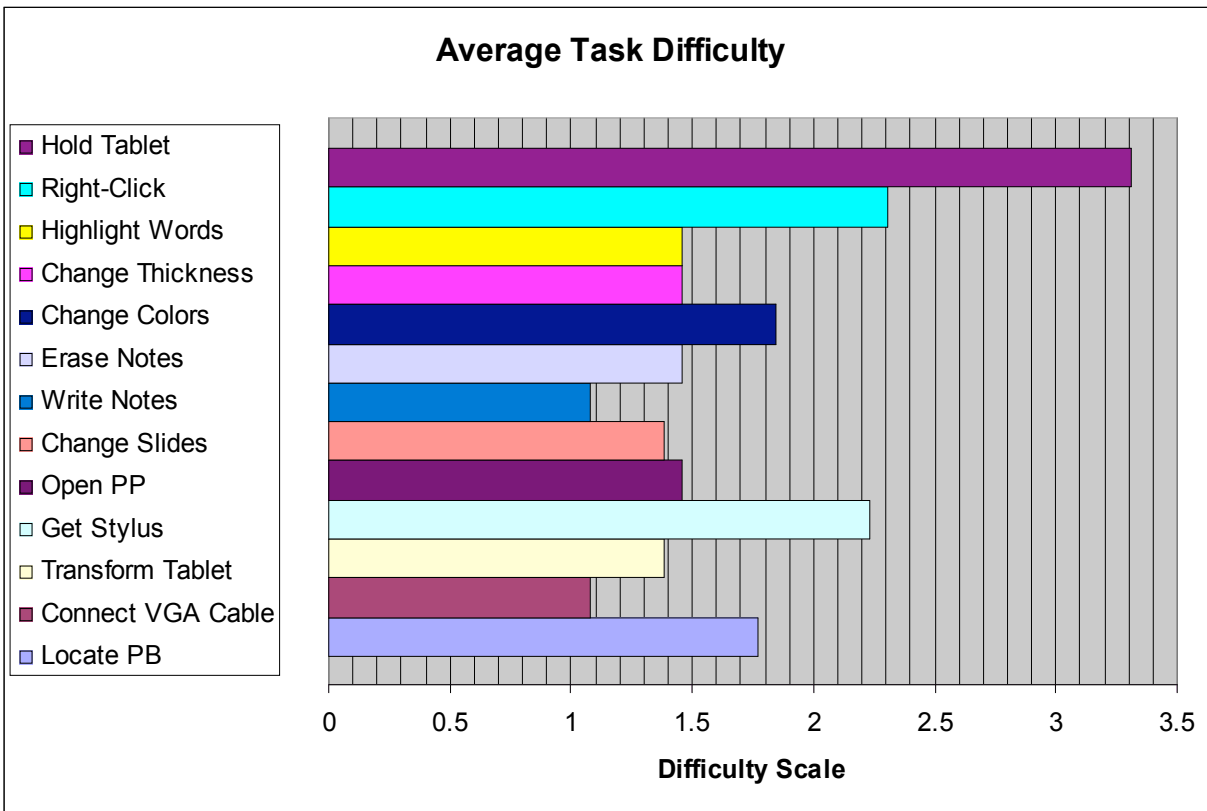


Figure 1: Compiled Tablet PC Usability Study Survey Data

Discussion of the Results

As can be seen from Figure 1 above there were certainly some mixed results involved in this data collection activity. For low rated difficulty tasks like connecting the VGA Cable, locating the power button, and transforming the PC into “tablet” mode, there was little variance between participant responses to the survey. Researcher observations frequently noted how participants completed the low rated tasks with ease. For these tasks, there was little to conclude except that the average surveyed participant can perform simple tasks.

The data shows participants rating the task of writing notes on the tablet PC as not difficult, but observations of the researchers indicate otherwise. This discrepancy is in part due to the wording on the survey which only asked about the difficulty of “writing notes” and made no mention of switching into the mode where a participant could write on the tablet. We were more interested in the participant’s ability to locate the menu that allowed the participant to switch between cursor mode and pen mode, as this was a menu that must be accessed often. We observed much frustration on the participant’s part when the participant attempted to write on the tablet and instead ended up changing slides. We believe this problem lies solely with the poor wording choice of the participant survey and not the participants themselves. We were unable to confirm our expectations from our initial study that changing modes with the stylus was a weak point of tablet PC usability.

Other remaining tasks, such as obtaining the stylus and right-clicking using the stylus had mixed reactions. For obtaining the stylus, some participants found it right away and located the EJECT button with ease while a couple of participants spent over a minute on this task and needed a hint in order to perform it. We believe this is in part due to the poor location of the stylus and due to the poor choice of an EJECT button. The first intuition of most participants was pushing in the stylus to eject it. Also, right-clicking using the stylus was quick and simple for some participants, but agonizingly painful for others. We expected some difficulty in this task since we had some difficulty ourselves. What made it the most counter-intuitive task was the

buttons on the stylus give no indication of right-clicking. The participant had to push and hold the stylus on the same spot on the tablet screen to bring up the right-click menu. The experienced participants brought up the right-click menu right away, although we did have a few experienced participants who made several attempts to make the right-click menu appear. Overall, we found this task to be one of the most irritating flaws of the tablet PC since it was such an important feature that could have been better designed.

Finally, there was one task that was difficult for all participants - holding the tablet PC during the experiment. The specific complaints included the tablet being too heavy, the cables being placed in a position that made holding the tablet difficult, and the tablet battery adding extra weight. We think the problem of cable placement can be solved by either making cable connections wireless or placing the cables in a different location on the notebook.

Evaluation of the overall experiment

Given the setup of the data collection, equipment used, forms developed for data collection, and the total number of participants, we were able to collect sufficient data to determine the strengths and weaknesses of the tablet PC as a teaching aid. We came up with a list of tasks we thought represented the complete set of activities a professor would have to perform when using the tablet, and having a participant actually do the activities is a way of finding out how intuitive the tablet PC makes each task. To ensure we could collect accurate data while giving participants enough freedom to complete each task on their own, we decided to have participants follow a prepared list of tasks that just outlined the goals while we observed their actions. Having the participants take a survey at the end would tell us which tasks seemed the most difficult, since all participants did the same tasks, and recording observations helped us determine what aspects about a task make it difficult to complete.

There are a couple of areas of the data collection that could use improvement. The first improvement would be to the language used to describe the goals in the mock lecture script. A few participants misinterpreted some of the words in the script and performed different actions than what we expected which caused us to lose track of what task the participant was currently performing. In the case of writing notes on the tablet, we were unable to accurately test a participant's ability to access the stylus menu since the participant was only rating himself or herself on the ease of physically writing words on the tablet screen. The second problem was recording observations of participants' activities by hand. While we looked down to write observations, the participant proceeded to the next task without us knowing it. It's possible we may have missed a couple of observations that might have told us more about the difficulty of a particular task.

Despite the described difficulties, the experiment produced some results that confirmed our expectations. While the tablet PC is not the easiest device to use for the inexperienced, there are still some features the tablet PC designers implemented correctly. All the basic actions were performed with ease by our participants, but there are still some aspects of the tablet needing improvement. The bulk of the tablet PC is a major concern, as well as the placement of the cables. Additionally, we would like to see the action of right-clicking be redesigned to be more intuitive. Still, given some time all of our participants were able to satisfactorily perform every task necessary to teach a tablet PC enhanced lecture to an audience, and that was the main goal in the end.

Recommendations for redesign of the HP tc4200

This section examines areas in which the HP tc4200 Tablet PC could be improved, and proposes a remedy for each area.



Figure 2: The original stylus design for the tc4200

Physical usability problems

There are several ways in which the poorly designed physical aspects of the HP tc4200 Tablet PC contribute to poor usability.

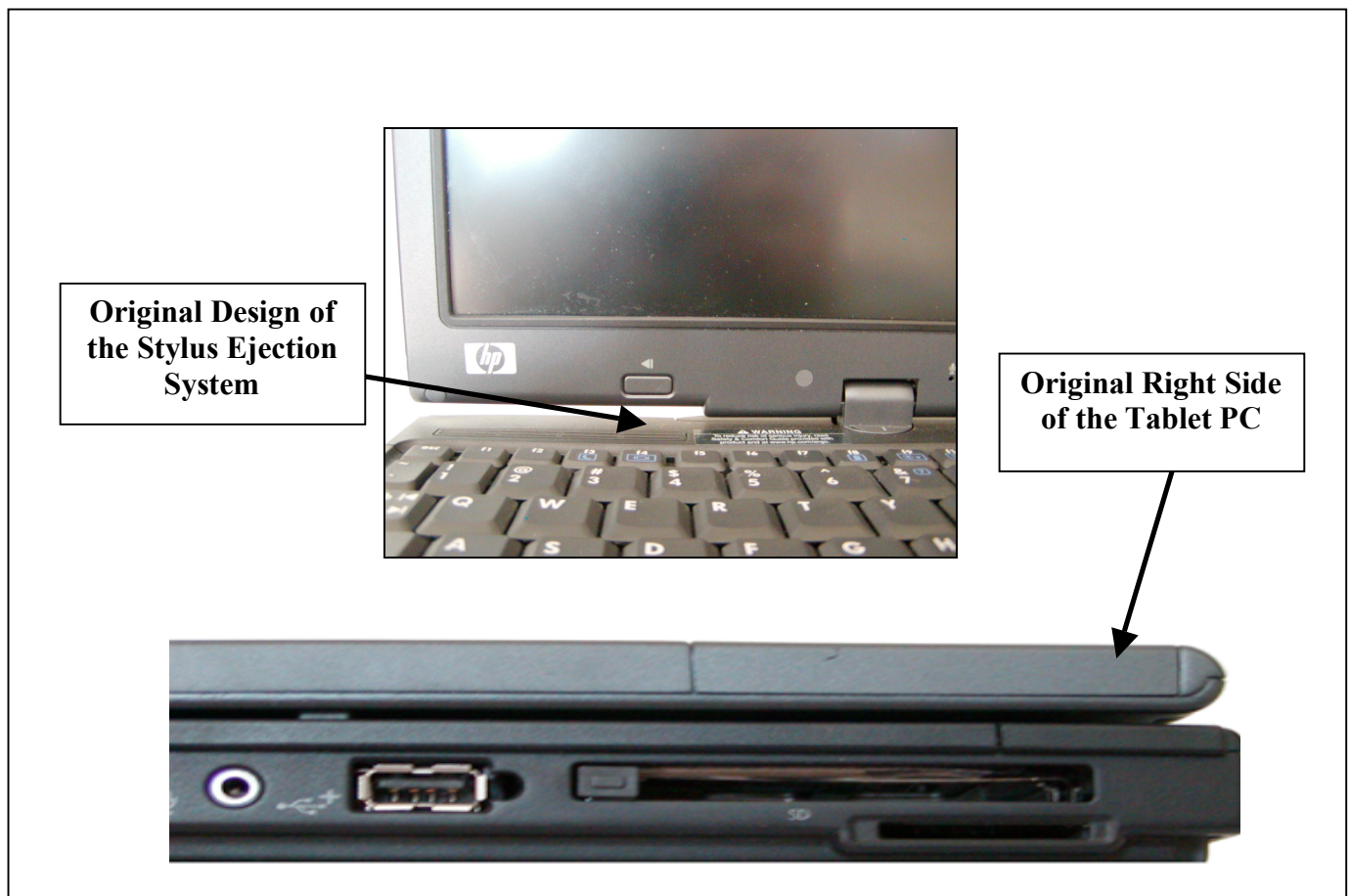


Figure 3: The original location of the stylus port and its ejection system.

Weight

The HP Tablet PC is much too heavy for regular use as a “tablet” format held in one arm. In order for the tablet to be natural, it must be light enough to be held in the non-dominant hand for extended periods of time. In our testing, most participants and all team members noted the arm fatigue resulting from holding the Tablet PC for periods as short as five minutes.

The weight must be reduced at all costs, even at the expense of battery life, screen size, or processor speed, as the Tablet PC we tested was simply unusable in its intended fashion. A Tablet PC would optimally be 1-2 pounds.

Stylus

We identified three usability problems related to the design of the stylus shown in Figure 2 above and its housing shown in Figures 3 above, each of which appear to have simple remedies.

Gaining access to the stylus

The HP Tablet PC has a “silo” that contains the stylus. In order to retrieve the stylus, the user must press an “eject” button located on the front of the tablet PC in a location that is not obviously related to the stylus in any way. The stylus then pops out partly and can be easily extracted. Additionally, the location of the “eject” button inside the tablet PC makes it impossible to get the stylus without opening the computer.

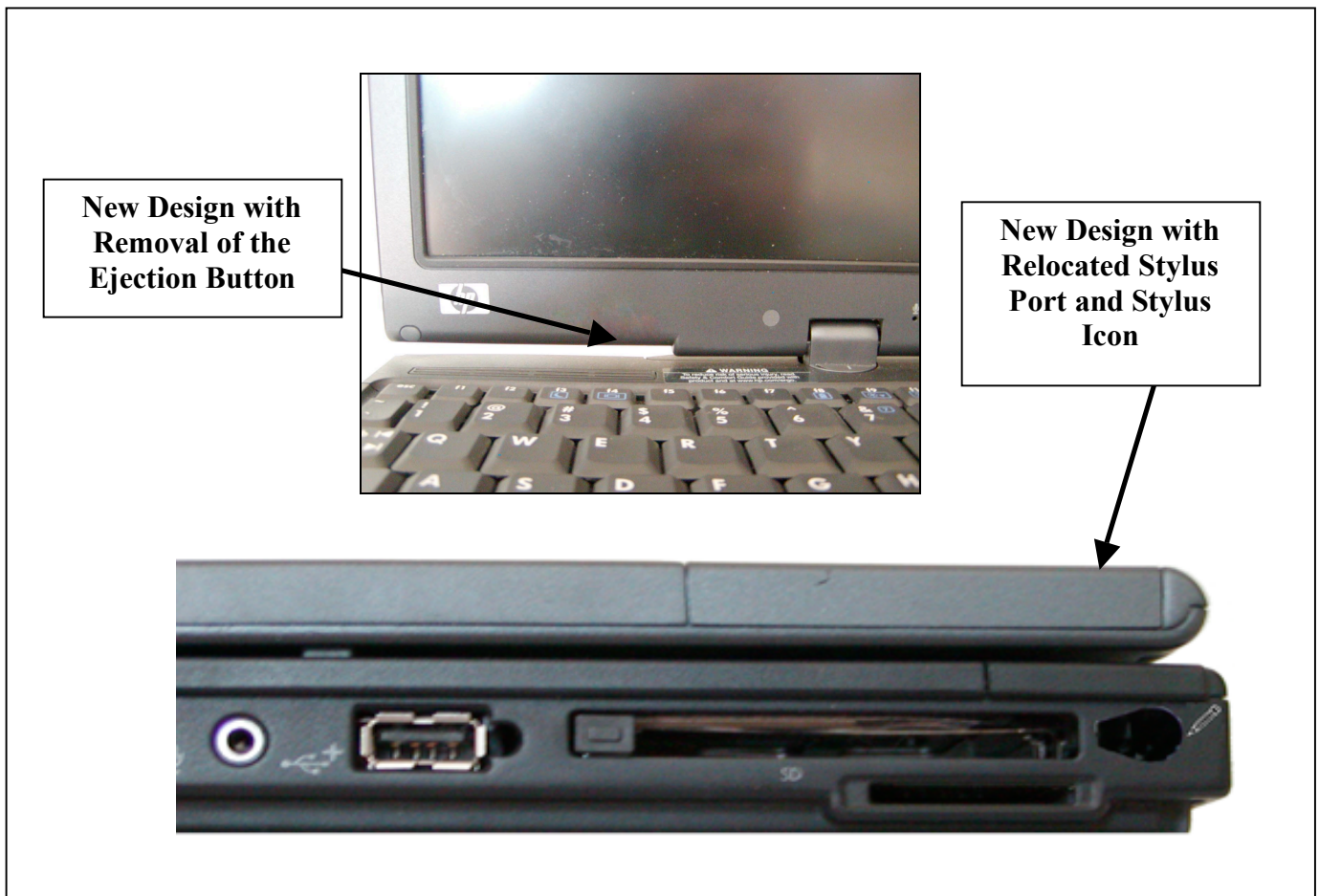


Figure 4: The modified location of the stylus port and its revised ejection system.

In our usability testing, we discovered that locating the stylus did not pose a challenge, but discovering the eject button was significantly more difficult and took some time for most participants. Upon finding the stylus, most users initially attempted to press on the end, expecting the stylus to “spring” free from the tablet PC. A mechanism that supports this action would be of approximately the same complexity as the current eject button, and indeed is used by some palmtop computers. Dropping the eject button and moving to a press-to-eject system would yield large usability benefits for the novice user. The proposed design for the new location of the stylus “silo” and the erasure of the “eject” button from the tablet PC altogether is shown in Figure 4 above.

Eraser function not apparent

The included stylus has an “eraser” located on the end opposite the tip. In programs that support it, turning the stylus around and using the eraser end will temporarily switch to the eraser tool, which is much more convenient than having to change tools each time a user wishes to switch between drawing and erasing. Unfortunately, the physical appearance of the eraser is not very distinctive, and a significant number of our test subjects did not realize that the stylus possessed this feature.

Wacom Technology Corporation, the leading manufacturer of digitizer tablets, has shown that by simple use of contrast, the eraser can be emphasized. Ansel, one of the researchers, owns such a tablet. The eraser is brightly colored and is obviously a control that the user can interact with. We have adopted this simple solution in our modified stylus design shown in Figure 5 below.



Figure 5: The modified stylus design with added mouse buttons and edited eraser color.

Pen feel very unnatural

The pen tip is hard, conical, smooth, and the surface of the screen is quite smooth. This results in a pen feel that is more like writing on glass than paper, which is fairly unnatural and frustrating.

Wacom has also solved this problem in their line of tablets, namely by applying a coating to the surface. Even if it were to reduce the display quality slightly, such a coating would improve the experience of writing on the tablet a great deal.

Right-click very difficult

The stylus has a small button on the barrel, near where the user's index finger naturally rests. When asked to right-click, nearly all test subjects pressed that button, which for some reason is mapped to “drag” rather than a right click. In order to register a right-click, the user must press the pen down, and hold it down without moving for 2 seconds. This gesture was not intuitive to anyone and is difficult even for people with experience using the tablet PC.

Simply remapping the already available side button to right-click would be an instant improvement. Right-clicking is very hard to do without a dedicated button. There is no reason to have a button dedicated to dragging, however, since it is a very natural gesture to make with the pen. The previously mentioned Wacom stylus has a rocker switch with one end mapped to the right mouse button and the other end mapped to the middle mouse button. Having two “buttons” available on the stylus would be helpful and so we have adopted this change in our modified stylus.

Figure 6: The original view of the left side of the tc4200

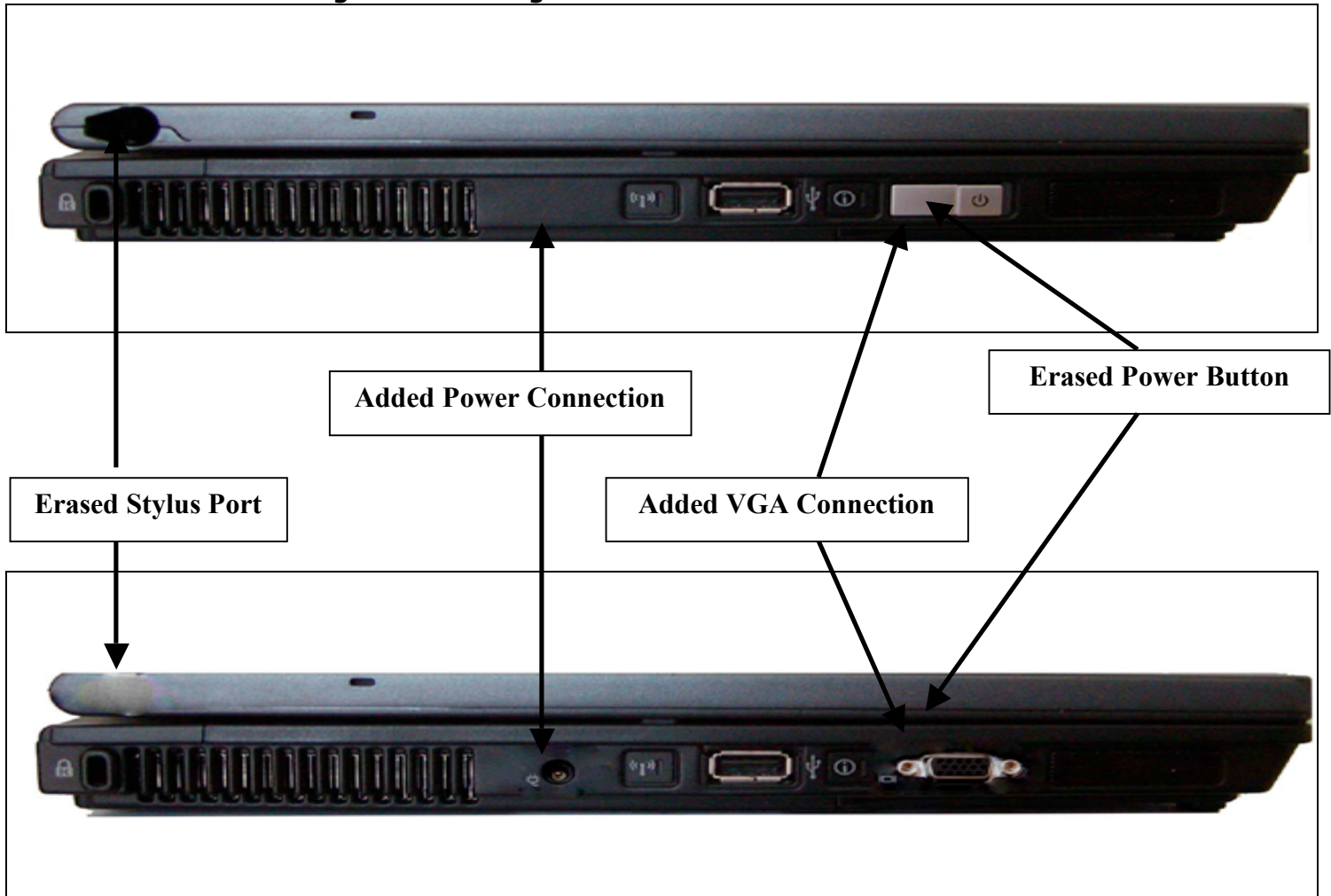


Figure 7: The modified view of the left side of the tc4200 with the added VGA connection and power connection and deleted power

Video Cable and Power Connection

The video cable and the power connection hanging off of the tablet PC were quite irritating, but they were even more annoying since both cables’ connections were located on the back side of the tablet, the same side that a professor would have pressed against their body when holding the tablet for a lecture. Not only does a professor using the tc4200 have to deal with the unreasonable weight, but they also have to handle the awkwardness of two cables sticking into their stomach.

A wireless video cable would be a tremendous improvement to eliminate the VGA cable completely, although even a lighter and smaller video connector would help quite a lot. However, for a simple solution to the problem of both the video cable and the power connection, we propose that both cable

ports on the tablet PC be moved to the left side of the tablet where they will not be potentially damaging any vital organs. The original layout and the proposed new layout are shown in Figures 6 and 7 above respectively.

Power Button Location

Our studies showed that the power button is in a very non-intuitive location. Most of the participants in the usability study assumed that the power button was on the inside of the tablet PC and so they would open up the computer and search the keyboard for the power button. The advantage of a power button on the inside is that it is nearly impossible to accidentally press. We experienced many cases where we would find our tablet PC on in our backpacks by accident. Therefore, we simply moved the power button to the inside to make the button easier to locate as shown in Figure 8 below.

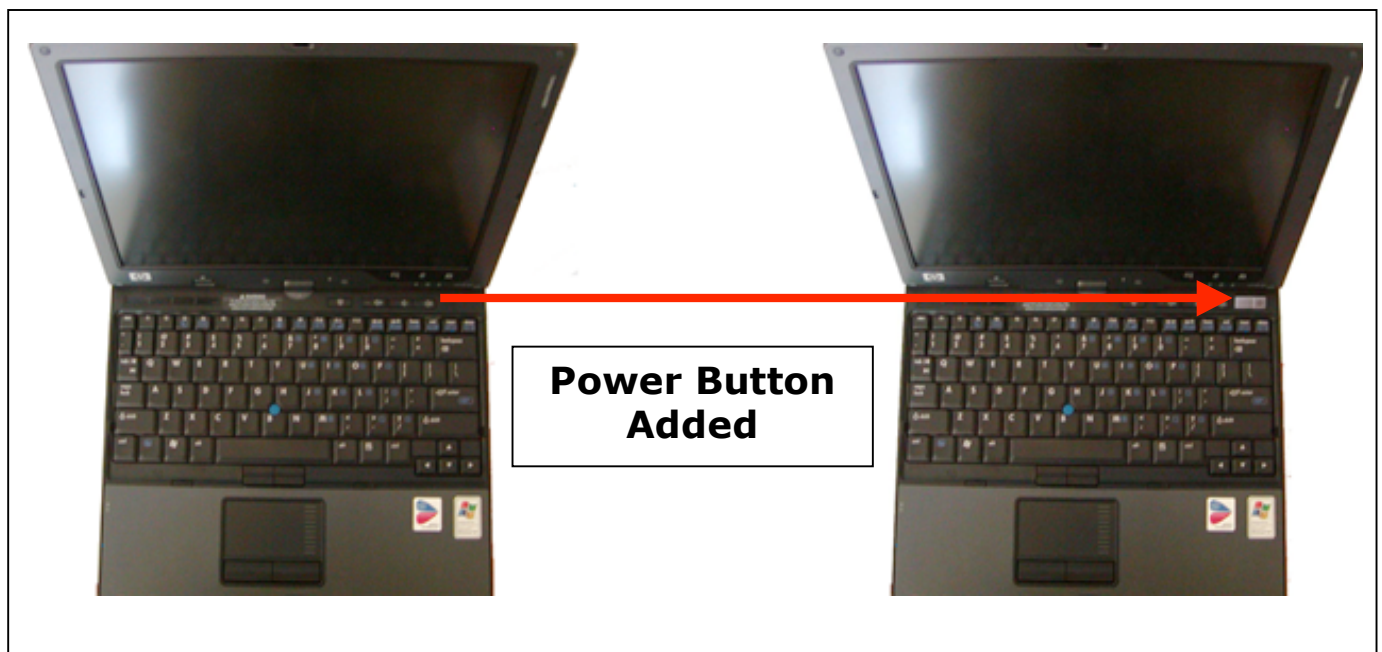


Figure 8: The addition of the power button to the inside of a HP tc4200

Software Usability Problems

There were several areas in which poor software design lead to usability issues. Some of these issues were a result of poor design in Windows for Pen Computing, and some were problems in the design of PowerPoint used on a tablet PC.

Windows problems

Windows for Pen Computing has a long way to go before it is a polished tool for presenting material in a classroom. The major problems we encountered were:

Display resolution

When first attempting to connect our tablet PC to the projector, we ran into major problems getting a stable video output. We traced this problem to the fact that the projector had a maximum resolution of 640x480, and Windows would not allow us to set that resolution directly. The smallest resolution available in the Display Properties dialog box was 800x600, which was not compatible. Dragging the resolution all the way down resulted in the portrait mode of 600x1280, which is not a resolution that any projector usually does not support. We eventually found that if we went to the advanced settings and directly to the video driver, we could force the external video to 640x480.

Since there are still many projectors operating at a resolution of 640x480, the normal display settings dialog should allow the user to set to that resolution.

Display orientation

The tablet PC offers the ability to rotate the orientation of the display, as the tablet is much more comfortable to use in a “portrait” mode. However, this feature is useless in our scenario since the video being displayed on the projector is rotated and letterboxed as well. The inability to specify differing rotation settings for the tablet and the external video leads to severe physical usability problems. The tablet is not designed for use in normal “landscape” mode.

A software improvement in display handling would yield major physical usability benefits in comfort.

PowerPoint problems

PowerPoint has several issues that severely impact its usability on the tablet PC.

Display homogeneity

This is a special case of the Display Orientation issue explored above. The user interface available to the presenter while the presentation is running is very spartan and not conducive to illustrating the presentation. Since the screen shown to the presenter is the same as the screen displayed on the projector, the UI must be minimal so as not to hide the presentation.

If PowerPoint were able to display different screens on the tablet PC and on the projector, the presenter could have access to a much better interface.

- All extraneous elements could be removed from the projected slides. In the current implementation, there are forward and back buttons and a small menu displayed in the corner which looks unprofessional and somewhat distracting.
- A small floating toolbox containing the drawing tools and a small selection of colors could be permanently displayed to the presenter, making the interaction much more immediate and reducing the number of clicks required. An example of this floating toolbox can be seen in Figure 9 below.
- A slide sorter view could be shown on the presenter's screen as it would give them a better view of their position in the slide show and help the presenter make transitions smoothly.

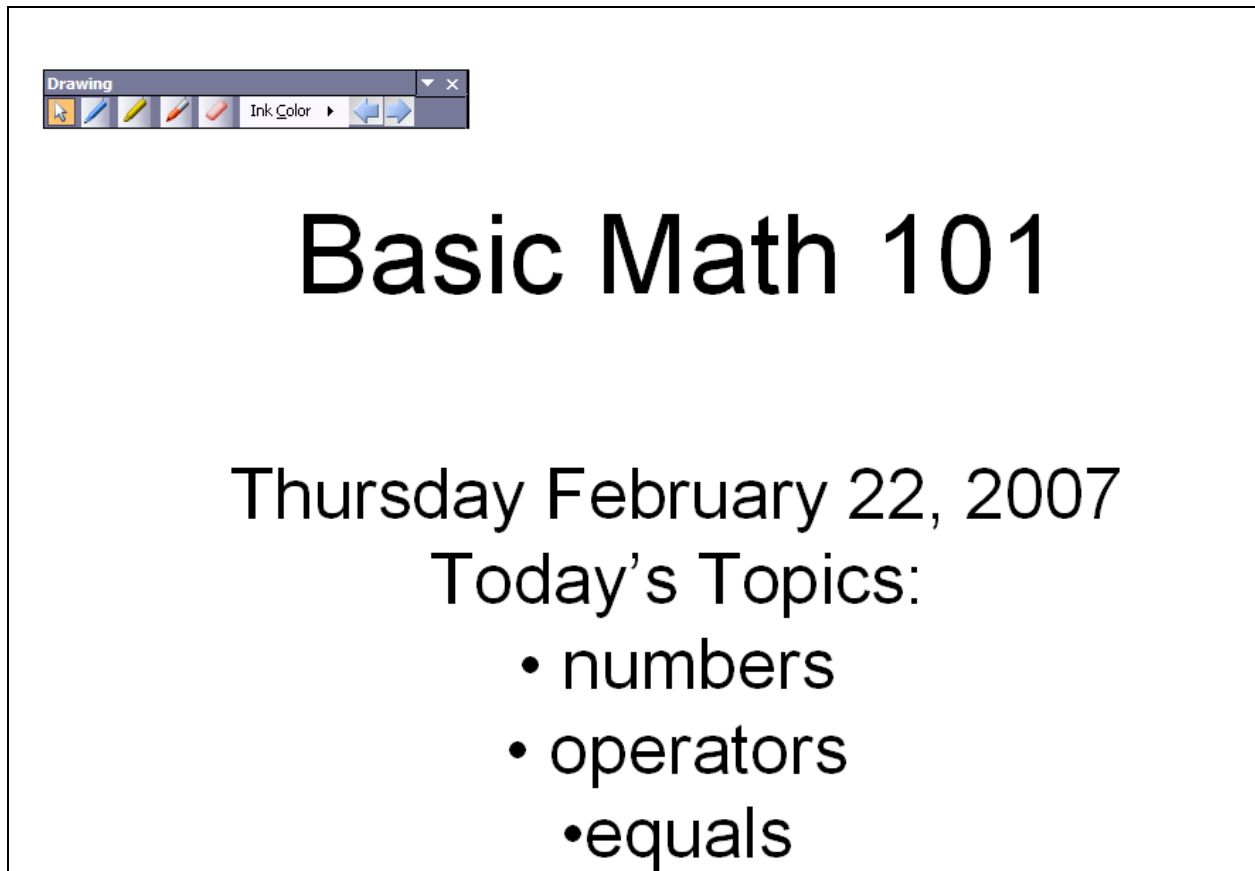


Figure 9: The floating stylus menu would appear on a professor's tablet PC, but would be hidden from view on a projector.

Context menu design

When the presenter finally learns how to right-click on the tablet PC, the context menu that PowerPoint provides leaves much to be desired. The "Pointer Options" menu grants the user access to the pen options (color, thickness, etc.), but requires several clicks to access. If the user misses on any of these clicks, the presentation advances to the next slide. In a bizarre UI inconsistency, the submenus do not behave rationally. In most areas of Windows, submenus are displayed to the right of their parent menu, unless there is insufficient room. In such a case, submenus are displayed to the left. On this particular context menu, the placement of submenus is nonsensical. The submenus usually gravitated to the left, but occasionally gravitated to the right. This presents an inconsistent UI which is quite frustrating and needs much more visual feedback to navigate effectively.

Once the right-click issue is solved, the context menu should be redesigned to present fewer levels of nesting and should use normal windows idioms for submenu placement.

Writing Text Using the Stylus

Once the tablet PC is in "tablet" form, there is obviously no way the keyboard can be accessed to add text to a presentation. This can present a problem for those that don't have text-like handwriting with a stylus. Windows came up with the solution of a pop up keyboard that a user can use to enter text characters by pushing on the simulated keyboard with their stylus. Seeing as there is only one stylus and most users type with eight or more fingers, the person using the stylus is at a major disadvantage. There is little that can be done with this discussed method, but PowerPoint offers several new options that are discussed below:

- The first option is to enter a special mode where you draw in a very specific field and then have everything in that field converted to text after you spell-check it. This feature has some minor quirks with the handwriting recognition, but the major flaw of this feature is that there is only one known way to enter this special mode – by tapping an icon that in our opinion is misleading as to its function. The current icon is a keyboard, but what you get when you click the icon is a place to draw ink and convert it to text. Our simple solution is to use an icon that is more suggestive to its function as shown below in figure 10.

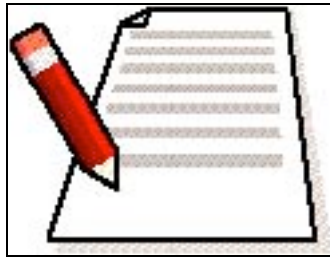
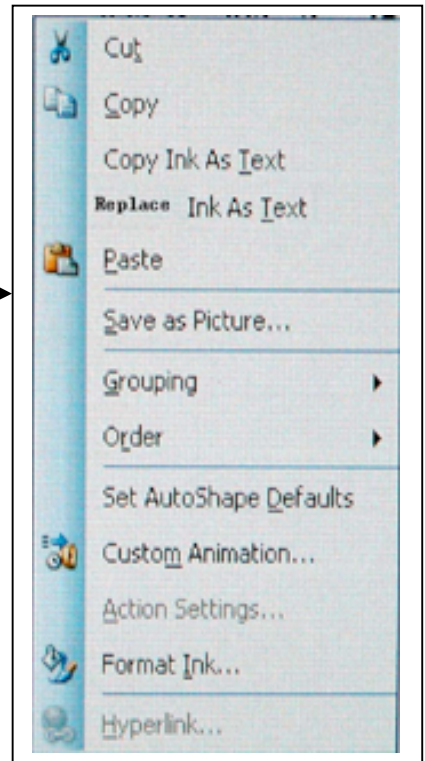
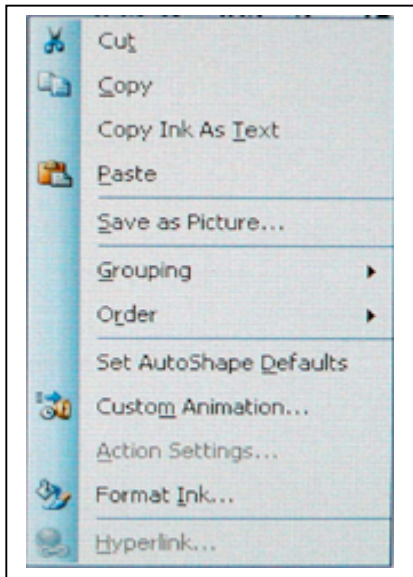
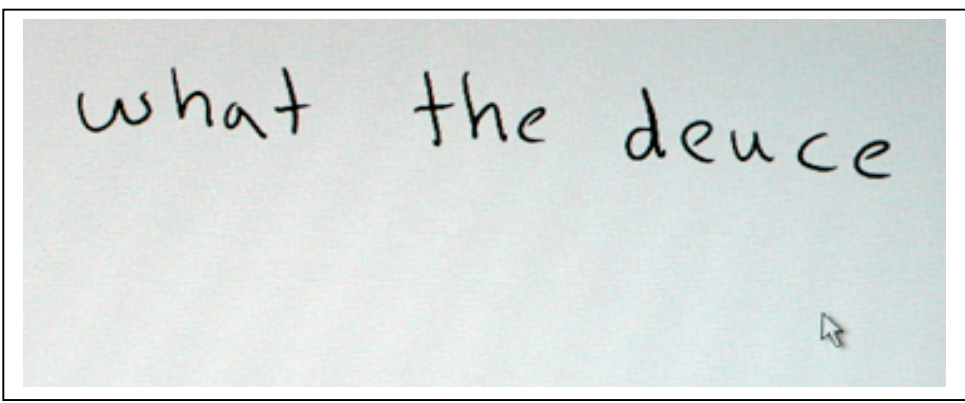


Figure 10: This clickable icon would appear each time the user could insert text with the stylus.

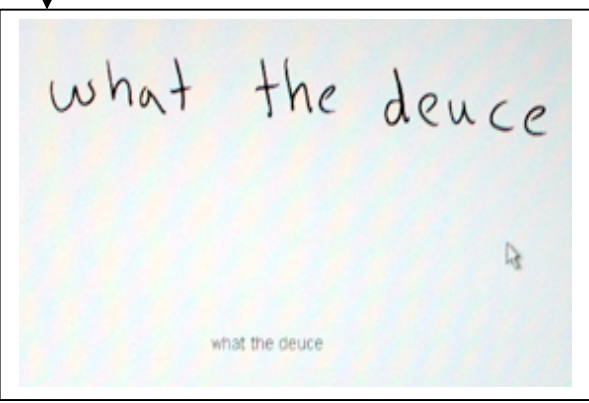
- The second option is to allow the user to draw the ink themselves with the stylus and then use a handwriting recognition feature to convert that ink into text. The biggest problem here, besides the modest capabilities of the handwriting recognition software, is the only option is to copy the ink and then have the pasted in text form where it appears disproportional to the ink, several inches below the location of the original ink, and the original ink still remains. The solution to this problem is to add an additional option to the same menu that will replace ink with text. The difference here is that the “Replace Ink as Text” option will delete the original ink and replace it with text that is both in the correct location and correct size. A simulation of this new option can be seen in Figure 11 on the next page.



Original Ink



**Result of option
"Copy Ink as Text"**



**Result of option
"Replace Ink as Text"**

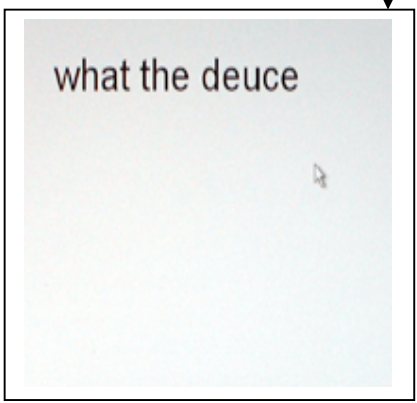


Figure 11: A proposed idea for a new option to "Replace Ink with Text" in PowerPoint that appears in the right-click menu when using the "ink" feature to draw notes with the stylus.

General Conclusions

Since this project is essentially the culmination of all of the work from the whole quarter, there is definitely a lot to look back and reflect upon. All of the conclusions specific to the project have been made, but there are a couple of things that have been left unsaid regarding the project as a whole. We certainly all agree that this has been a great learning experience since it took all of us outside of our normal programming box and had us examine aspects of usability from the perspective of the user. Since the user is generally the target audience for any programming project in industry, it is important to examine what users want rather than being egotistical programmers who think they know everything. By looking at all aspects of the tablet PC and obtaining a significant amount of feedback from outside sources, we have been able to step out of our comfort zone and gain some perspective about an important part of software design. Overall, this project has been a great experience and we all feel that much of the knowledge we gained has been only a first lesson for what we will all likely be doing for our professional careers.

APPENDIX

INFORMED CONSENT FORM FOR PARTICIPATION IN TABLET PC USABILITY EXPERIEMENT

INFORMED CONSENT TO PARTICIPATE IN TABLET PC USABILITY STUDY

An experiment on tablet pc usability as a teaching aid is being conducted by Devin Sabo, Ansel Sermersheim, and Tyler Vodak in the Department of Computer Science at Cal Poly, San Luis Obispo. The purpose of the study is to collect data on the usability of the tablet pc as a teaching aid for college professors. The purpose also includes completing the requirements for assignment three assigned by Professor Franz Kurfess for CPE 484 section three.

You are being asked to take part in this study by giving a mock lecture of a math lesson using a computer projector and a tablet pc. You will be required to follow a prepared script outlining several tasks that must be completed while giving your mock lecture. During your lecture, the researchers will be recording observations on how you complete each of the tasks detailed in the script. When you are finished, you will be asked to complete a survey with questions asking how difficult you thought it was to use the tablet pc. Your participation will take approximately five minutes. Please be aware that you are not required to participate in this experiment and you may discontinue your participation at any time without penalty. When answering the questions on the survey, you may omit any items you prefer not to answer.

The possible risks associated with participation in this experiment include developing a sore arm from holding the tablet pc, a cramped hand from holding the stylus, or feeling the bottom of the tablet pc get warm. If you should experience muscle strain in your arm or any discomfort in your hands, please be aware that you may contact the Health Center at (805) 756-1211 located in Building No. 27 next to the Rec Sports building for assistance.

Your confidentiality will be protected by not requesting any personal data that could identify you to a particular instance of data. In other words, the researchers will not ask for any personal information that could separate you and your data from the rest of the participants. We also request you do not state any personal information about yourself or write any of your personal information on the mock lecture slides or the survey. Your responses will be provided anonymously to protect your privacy. Potential benefits associated with this study include determining the usability of the tablet pc as a teaching aid and helping the researchers of this experiment receive a good grade on assignment 3 for CPE 484.

If you have questions regarding this experiment or would like to be informed of the results when the experiment is completed, please feel free to contact Devin Sabo, Ansel Sermersheim, or Tyler Vodak at kodavx86@gmail.com. If you have questions or concerns regarding the manner in which the study is conducted, you may contact Steve Davis, Chair of the Cal Poly Human Subjects Committee, at 756-2754, or Susan Opava, Dean of Research and Graduate Programs, at 756-1508.

If you agree to voluntarily participate in this research project as described, please indicate your agreement by signing below

Signature of Researcher

Date

MOCK LECTURE SCRIPT

A Day in the Life of a Professor

Task 1: Locate the power button (Please do NOT push the power button).

Task 2: Open the Tablet PC and transform it into tablet mode.

Task 3: Connect the projector's VGA cable to the back of the Tablet PC.

Task 4: Prepare to use the tablet PC.

Step 1: Pick up the Tablet PC and hold it comfortably.

Step 2: Take out the stylus pen.

Task 5: Open up the provided PowerPoint lecture.

Step 1: Using the stylus, open the PowerPoint application.

Step 2: Open the file "Basic Math 101 Template.ppt".

(C:\Documents and Settings\stadmin\My Documents\PPT_Proff_Pres)

Step 3: Start the slide show.

Task 6: Change from the title slide to the slide "Basic Concepts – Numbers".

Task 7: Write some examples on the "Basic Concepts – Numbers" slide.

Step 1: Write the numbers 1, 2, 3, and 4 on the slide below the first bullet point.

Step 2: Erase the numbers 2 and 4.

Step 3: Draw a picture of two trees and write the number "2" next to the picture under the second bullet point.

Task 8: Change the color, thickness, and type of stylus to highlight key concepts.

Step 1: Move to the next slide titled "Basic Concepts – Operators" .

Step 2: In a different color, draw the operators +, -, and %.

Step 3: Highlight the word "operators" in the first bullet-point of the slide.

Step 4: Draw some "thicker" arrows from the word "operators" to the previously drawn and highlighted operators.

Task 9: Use illustrations to better clarify the example question.

Step 1: Move to the next slide titled "Example Question".

Step 2: Draw a picture illustrating the problem described in the example question.

Step 3: Open the right-click menu and end the slide show.

Task 10: Use the drawing features of PowerPoint to mimic the given Basic Geometry slide

Step 1: Create a new slide

Step 2: Using only the stylus and PowerPoint, create a new slide that looks as much as possible like the Basic Geometry slide

Task 11: End the Lecture.

Step 1: Close the PowerPoint application (Do NOT save your changes, thank you).

Task 12: Cleanup.

Step 1: Return the stylus to its original location.

Step 2: Close the tablet PC.

MOCK LECTURE SURVEY

Please **CIRCLE** your answer to the questions below using the following scale:

1 = Not Difficult 2 = Slightly Difficult 3 = Somewhat Difficult 4 = Very Difficult

1) How difficult was it to locate the power button on the Tablet PC?

1 2 3 4

Where was the first place you looked?

2) How difficult was it to connect the Tablet PC to the projector?

1 2 3 4

3) How difficult was it to change the Tablet PC into "tablet" form?

1 2 3 4

4) How difficult was it to locate and obtain the stylus?

1 2 3 4

What was the first thing you tried to eject the stylus?

5) How difficult was it to start PowerPoint and bring up the lecture slides with the stylus?

1 2 3 4

6) How difficult was it to change slides with the stylus?

1 2 3 4

7) How difficult was it to change from cursor-clicking mode to pen mode where you could draw on the screen?

1 2 3 4

8) How difficult was it to write notes on the slides using the stylus?

1 2 3 4

Did you feel like you were writing on paper?

9) How difficult was it to erase notes on the slides using the stylus?

1 2 3 4

Did you feel it was intuitive to erase using the back of the stylus?

10) How difficult was it to change the color of the pen using the stylus?

1 2 3 4

11) How difficult was it to change the thickness of the pen using the stylus?

1 2 3 4

12) How difficult was it to highlight words using the stylus?

1 2 3 4

13) How difficult was it to access the right-click menu using the stylus?

1 2 3 4

Would a right-click button on the stylus be a good addition?

14) How difficult was it to hold the Tablet PC in your arm during the lecture?

1 2 3 4

15) Rate the following aspects of the tablet PC that made holding the tablet PC difficult (1 being the most difficult):

The VGA Cable The Power Cable The Battery The Overall Weight The Heat from the Fan

Observations of Mock Lecture

- 1) How well did the participant change the Tablet PC into “notebook” form?
- 2) How well did the participant connect the Tablet PC to the projector?
- 3) How easily did the participant locate and obtain the stylus?
- 4) How well did the participant start PowerPoint and bring up the lecture slides with the stylus?
- 5) How well did the participant change slides with the stylus?
- 6) How well did the participant write notes on the slides using the stylus?
- 7) How hard was it for the participant to erase using the stylus?
- 8) How well did the participant change the color of the stylus?
- 9) How well did the participant change the thickness of the stylus?
- 10) How hard was it for the participant to access and use the right-click menu?
- 11) How easily did the participant mimic the Basic Geometry slide?
- 12) How hard was it for the participant to hold the Tablet PC in his/her arm during the lecture?