AC 2011-443: ADOPTION OF THE TABLET PC BY THE ENGINEERING EDUCATION DEPARTMENT AT VIRGINIA TECH

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Abstract

The College of Engineering (COE) at Virginia Tech is considered to be a forerunner with using new technology to enrich the teaching and learning experience. In 1984, they were the one of the few universities who had a personal computer requirement. In 2002, they had a laptop requirement for all engineering students and in 2006; the COE started the Tablet PC initiative which required all incoming engineering freshman students to purchase a Tablet PC. The department of ENGE is the first stop for engineering students within the college as all incoming freshman are required to take two introductory courses offered by the department. A qualitative investigation revealed that ENGE's faculty members not only readily adopted the tablet PC but have also helped faculty members outside of their department learn how to effectively use the Tablet. Some of the faculty members within this department are also considered to be champions of other forms of instructional technologies. The COE has been finding it challenging to get other departments to wholeheartedly accept the tablet PC like ENGE did and are using the results of this study to assist in identifying strategies that can assist with greater diffusion of instructional technology across departments.

Introduction

The College of Engineering (COE) at Virginia Tech is considered to be a forerunner with using new technology to enrich the teaching and learning experience. In 1984, they were the one of the few universities who had a personal computer requirement. In 2002, they had a laptop requirement for all engineering students and in 2006; the COE started the Tablet PC initiative which required all incoming engineering freshman students to purchase a Tablet PC. The department of Engineering Education (ENGE) is the first stop for engineering students within the college, as all incoming freshman are required to take two introductory courses offered by the department. ENGE is one of the few departments within the college that has readily adopted the tablet PC and uses it to teach in the classroom.

Previous research has shown that there are three main problems when it comes to adoption and diffusion of instructional technology and they are personnel related, cost related, and infrastructure related issues. Personnel related issues include organizational cultures that are hesitant to readily adopt new technologies. High cost of technology often prevents adoption and diffusion and finally, unless there is a facilitating infrastructure, that allows potential users to access equipment and software whenever they need to, it will be very difficult to successfully instructional technology [1].

The COE has been working on maximizing the use of the tablet PC in a number of ways. The COE created the Software Triage Team (SWAT) that is available 8 hours a day to provide free assistance to students who face technical trouble with the tablet PC. The Instructional Technology (IT) team is another team in the COE that works with faculty members and provides them training and in class support whenever they need it. The IT team also conducts research to understand both students' and faculty members' experiences with the tablet PC. The goal of this

study was to help the IT team understand what motivated the faculty members of ENGE, so that they could try and further diffuse this technology into other departments.

Theoretical Framework

Everett Rogers developed one of the most notable theories on diffusion of innovations. He defined the innovation-decision process as the process through which individuals go from gaining basic knowledge of the innovation, to developing an opinion about it, to finally deciding whether to accept or reject the innovation [3]. His current model of the innovation-decision process consists of 5 steps; Knowledge, Persuasion, Decision, Implementation, Confirmation (see figure 1).
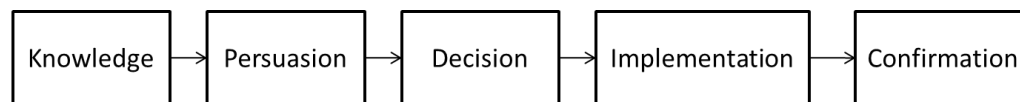

Figure 1. Roger's Innovation-decision process (adapted from Rogers (1963)

Rogers also classified five attributes of innovations. He was of the opinion that attributes describe an innovation and help predict rate of adoption depending on the individuals' opinion of the innovation. According to him, they are *Relative Advantage, Compatibility, Complexity, Trialability, and Observability*. Relative advantage is the amount to which an innovation is considered to be better than an older idea. In a way, it indicates the intensity of the award or punishment resulting from adopting the innovation. Compatibility is the amount to which an innovation is considered to be consisted with current values, prior experiences, and needs of likely adopters. The more compatible the innovation appears the certainty of adoption increases. Complexity is the amount to which an innovation is considered as difficult to comprehend and use. It is usually considered as a negative aspect. The more complex an innovation appears, the less likely that it will be adopted. Trialability is the amount to which an innovation may be tested on a limited basis. An innovation that can be tested by the user has better chances of adoption that one that has no trialability. Finally, observability is the amount to which the outcomes and results of an innovation are noticeable to others. The more noticeable the results of an innovation are, the more likely that the innovation will be adopted.

Rogers also classified users based on adoption characteristics [3]. According to him, there are five types of users: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. Innovators are described as being "venturesome", and they try out new gadgets with enthusiasm. Early adopters are not as venturesome as innovators but their opinions on the new products are respected by their peers. The early majority hesitates before deciding to adopt an innovation, but they stand between those who adopt very early and those who adopt late. The late majority is described as being 'skeptical' and usually adopts a technology due to peer pressure and/or necessity. They usually have scarce resources so it is absolutely necessary that the technology works very well before they decide to adopt it. The final category is that of the laggards who the last to adopt a technology. They do not trust new innovations as well as opinions of peers. They have to be absolutely sure that the innovation will be successful before they adopt it. ENGE can be considered to be early adopters since they readily adopted and used the tablet PC. Rogers'

framework, and in particular, the attributes of innovation, were used as the theoretical framework for this study (See Figure 2).
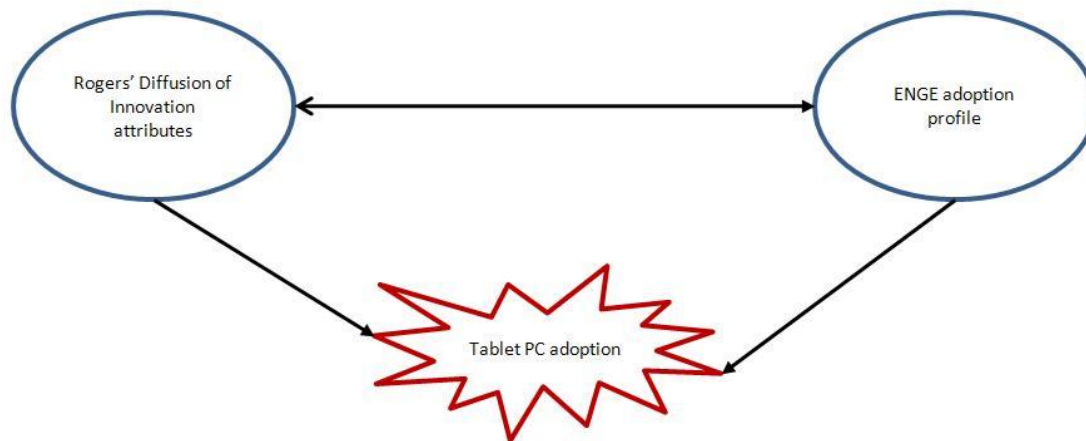

Figure 2: Conceptual framework of study

Methodology

A focus group interview was conducted because it has been found to be useful to get opinions from a group of people [2]. A 30-minute focus group interview of all the ENGE faculty members was conducted and was facilitated by two researchers. Three main questions were asked to the faculty members. They were:

1. What motivates you to use the Tablet PC?
2. What barriers have you faced using the tablet PC?
3. What suggestions do you have to facilitate adoption of the tablet PC?

The interview was recorded using an audio recorder and transcribed verbatim. The transcription was analyzed using codes based on the attributes of diffusion from Roger's (1963) diffusion of innovations theory.

Results

Motivations to use the tablet PC

Faculty members of ABC listed their motivations to use the tablet PCs. They were found to connect to Roger's attributes of diffusion [3]. A summarized list of the motivations and the corresponding attribute are shown in Table 1 and then described in detail.

Table 1. Summary of Motivators for Using the Tablet PC by Diffusion Attribute

Attribute	Motivation to use the tablet PC
Relative advantage	Efficiency
	Student demand
	Online Classes
	Ability to shrink classroom
	Ability for students to interact
Compatibility	Large classrooms
	COE's Technology Policy
	ABC's policy
	Existing teaching styles
	Course Co-coordinators
Observability	Students get more involved
	Champions of tablet pc have good results
	PhD graduate students can use it to teach
Trialability	COE loaner tablet PC
	Tried it from other faculty members
Complexity	Team-teaching
	Course Coordinators
	Instructional Technology Team

Based on the analysis, a number of reasons related to the relative advantage of the tablet pc were found to motivate the faculty members to use it. Faculty members found that tablet PCs made them more efficient when it came to teaching with them in the classroom. They helped shrink a classroom which made it easier for faculty members who had to teach classes of more than 100 students each. They also allowed students to interact with each other and the professor, which made the teaching and learning experience a lot better. Faculty members observed that using this technology in the classroom made students a lot more excited about engineering. Some faculty members said that their main reason behind choosing a tablet PC was due to high student demand. Others said that they continued to use the tablet PC because they had good experiences with it in the past. Tablet PCs were also found to be extremely useful and helpful to teach online classes and software like DyKnow made electronic collaboration much more simple and efficient. Finally, some faculty members said that they main reason they preferred using the tablet PC was because they enjoyed staying current with technology.

In terms of compatibility of the tablet PC, faculty members felt that tablet PCs were extremely useful to teach in big classrooms. A lot of freshman engineering courses are held in big auditoriums, with over a hundred students, and faculty members who were already used to teaching those classes, felt that the tablet PC not only made it easier to teach these classes, but was also compatible with the teaching style employed in large lecture classes, including delivering lectures and providing additional detail and visualization for students through inked diagrams and PowerPoint slides using the stylus. This form of instructional technology was also compatible with the policies and value system of the faculty. Faculty members explained that using a tablet PC fit perfectly with Virginia Tech's COE's technology policy, which tries to encourage the use of newer, efficient technology, to improve the teaching and learning experience. The Tablet PC was also an integral part of the ENGE's departmental policies that emphasize the value of employing the latest technologies to teach and conduct research with. Some faculty members observed that the tablet PC also complemented their teaching styles and made the task a lot more efficient. For example, the ENGE course content was developed by course coordinators and they found a way to easily embed the tablet PC in the course. This made it very simple for different faculty members to teach courses with the tablet PC since the materials that were being used readily incorporated the tablet features. Others felt that the tablet PC was very useful for them because a lot of their courses involved students working in teams and using the tablet PC made team-based collaborations easier.

In terms of observability of the tablet PC, faculty members said that students seemed to enjoy the ability to get more involved in class and offer solutions. Tablet PC based software like DyKnow and Classroom Presenter allow more interactivity and collaboration in the classroom and students can observe other students get involved and this can turn as a motivation factor for them. Some faculty members also said that they were motivated to use the tablet PC because of the support that they were provided from others in their department; they were trained by faculty colleagues who considered themselves champions of the tablet PC. When the newer faculty members observed how well the tablet PC worked for them, they felt inclined to try using it in class. Faculty members now train graduate students who work as their teaching assistants on how to use the tablet PC and hope that they will continue to use it when they teach.

In terms of trialability of the tablet PC, faculty members said that they were motivated to use the tablet PC because the COE provided loaner tablet PC to faculty members who wanted to try them out. This put less pressure on faculty members who didn't want to buy it right away. Some faculty members said that they had a good experience with the loaner tablet PCs and that made them switch to using them permanently. Other faculty members also tried the tablet PC when they were introduced to it by other faculty members.

In terms of complexity, faculty members observed that team-teaching, where groups of faculty members took turns teaching a large class, really helped faculty members who were new to the tablet PC and thus they did not find them as complex to use. The College of Engineering also provides support in the form of graduate students who offer to train faculty members and provide in-class support for the first few weeks of school. Finally, as already mentioned, faculty members explained that the course coordinators reduced complexity by finding ways to use a tablet PC efficiently in the classroom, reducing the time individual faculty had to spend trying to develop and refine assignments that employed this form of instructional technology

Barriers to Possible Adoption

During the course of the focus group discussion, faculty members brought up a few possible barriers to adoption of the tablet PC. Faculty members felt that a huge obstruction to adoption of the tablet PC is that some students do not see the advantages of buying and using a tablet PC because other departments do not use them like ENGE does. This meant that if a handful of students did not have a tablet in class; faculty would have to alter assignments or teaching styles to accommodate those students. Some faculty members attributed the lack of student buy-in to negative experiences where faculty members in other courses were not aware of the benefits of using a tablet PC and opted not to use them. Others felt that the tablet PC may not be compatible with everyone's teaching style and unless they are willing to modify it, they may not be inclined to use the tablet PC. Faculty members also might not be aware of all the support resources that are available in the COE which could also make them hesitant to try the tablet PC. In terms of the features of the actual tablet pc, some faculty members brought up battery life and technical trouble that could deter adoption.

Steps Carried Out by the COE IT Team to Facilitate Tablet PC Adoption

The College of Engineering has an Instructional Technology (IT) Team, which consists of graduate and undergraduate students, and is supervised by the Director of Information Technology. They work on trying to maximize the *Relative Advantage, Compatibility, Trialability,* and *Observability* and reduce the *Complexity* of the tablet PC in different ways and have used these findings to design several initiatives. Suggestions for improvement of use from faculty members were also solicited during the focus group. Their suggestions were used to help frame the various initiatives underway in the college that related to Roger's Attributes of Diffusion

In terms of maximizing the relative advantage of the tablet PC, the IT team offers basic tablet PC training to faculty members at their convenience. They also teach short classes with the Faculty Development Institute (FDI) just before classes start in the fall and spring semesters. In turn, the FDI offers tablet PC tracks, which are sets of three day long courses on how to use different features and tablet PC based software efficiently.

To maximize compatibility of the tablet PC, before training a certain faculty member, the IT team attempts to understand their instructional methodology. This way, they can introduce them to the right level and type of technology. To simplify the process, faculty members are categorized into phases based on the types of technology they use to teach with. For instance, a faculty member who uses a laptop and software like PowerPoint will be categorized as a phase 1 user and a faculty member who uses basic features of the tablet PC will be categorized as a phase 2 user of the tablet PC.

In terms of observability, the IT team nominates faculty members, who use the tablet PC innovatively, for various awards. They also create brochures and flyers on the tablet PC for different events. In 2010, they invited key faculty members of different departments to the Workshop on the Impact of Pen based Technology on Education (WIPTE) which was held in

Virginia Tech, so that they could increase their understanding of the benefits of using a tablet PC.

In terms of trialability, the IT team loans tablet PCs for a semester to faculty members who want to try it out. They also meet and train faculty members who want to try new products or features of the tablet PC.

Finally, in terms of reducing complexity, they provide in-class support to those faculty members who use software like DyKnow to teach in class. As already mentioned, faculty members are divided into phases based on usage, so that they are introduced to the right level of technology. This prevents them from getting introduced to complicated features and/or software if they are not yet ready.

The IT team plans to use identify interested users by targeting specific users from those who've attended any of the Tablet track offered by the FDI. Once they are identified, the IT team plans to offer additional training to the faculty members. The IT team also wants to extend the use of tablet PCs to graduate courses. If faculty members are interested, the entire class could be loaned tablet PCs too. Finally, there is a four-year longitudinal study on currently on faculty members and their instructional strategies. The results of that study will be analyzed and used to guide further actions by the IT team.

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