

# Tablet PC Support of Students' Learning Styles

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## ABSTRACT

In the context of rapid technology development, it comes as no surprise that technology continues to impact the educational domain, challenging traditional teaching and learning styles. This study focuses on how students with different learning styles use instructional technology, and in particular, the tablet PC, to enhance their learning experience. The VARK model was chosen as our theoretical framework as we analyzed responses of an online survey, both from a quantitative and qualitative standpoint. Results indicate that if used correctly, the tablet PC can be used across different learning styles to enrich the educational experience.

**Keywords:** Learning Styles, Tablet PC, VARK, Instructional Technology, and Higher Education.

## 1. INTRODUCTION

In the context of rapid technology development, it comes as no surprise that technology continues to impact the educational domain, challenging traditional teaching and learning styles. If employed correctly by faculty and students, instructional technologies, in particular, have been found to benefit the learning experience. Research has also shown that it is important to understand learning styles and profiles of students in order to have the most effective teaching and learning experience. Multimedia technology has been found to have a positive effect on a classroom of students with different learning styles [1]. A recent study revealed that 70% of students surveyed believed that technology made course activities more convenient [2]. The same study indicated that 70% of the students surveyed use technology to learn by listening to audio and watching videos [2]. While these studies have provided useful information that can inform the design of the learning experience, fewer studies have focused on the degree to which learning styles might utilize instructional technology differently. This study focuses on how students with different learning styles use instructional technology, and in particular, the functionality offered by the tablet PC, to enhance their learning experience (as shown in Figure 1).

## 2. BACKGROUND

### Learning Styles

The concept of learning styles originated in the 1970s. It has been defined as different approaches to learning. While some researchers argue the most effective instructional technique is to first identify learning styles and then adapt their instructional method to each learning style [3], others suggest that there is no single efficient teaching method. They believe that educators should instead use a variety of instructional techniques [4]. In this technological era, it is important to understand the relationship between learning styles and the use and acceptance of technology.

Various instruments have been developed to understand learning preferences. The Learning Style Inventory [5], was developed to identify and categorize participants into four learning styles; Diverging, Assimilating, Converging, and Accommodating [5]. The Dunn and Dunn Learning Style Inventory [3] is based on the notion that students have learning style preferences which are divided into twenty-one variables that affect learning in five categories: Environmental, Emotional, Sociological, Physiological, and Psychological [3]. The Myers-Briggs Type Indicator [6] divides learning preferences into four dichotomies, which results in sixteen possible psychological learning types, including Extroversion versus Introversion, Sensing versus Intuition, Thinking versus Feeling, and Judgment versus Perception [6].

One of the most popular models is Fleming's VARK model [4], which divides learners into four categories: Visual (V), Auditory (A), Reading/writing (R), and Kinesthetic (K) (See Figure 1). Visual learners are those who learn best with visual artifacts like diagrams and pictures. Auditory learners are those that learn with oral stimulations, such as talking and listening. Reading and writing learners prefer printed words to gain knowledge. Kinesthetic learners are those who learn by experience. They learn by real world examples and by application. Learners can also be multi-modal, making use of two or more learning styles [4]. Since Fleming's VARK model is well-suited to examining student use of technology across disciplines and widely used, we have chosen this model as our theoretical framework.

The rapid ascent in computer technology and the Internet has contributed to an increase in using different media for education. Instructional technologies can range from using software like PowerPoint, to hardware like laptops and tablet PCs in the classroom. These media can improve the teaching and learning experience. Moore [7] found that the use of instructional technologies led to an increase in three types of interactions: between the students and learning material, students and instructor, and among the students. Various technologies have also been identified as useful for students who belong to Generation Y, who are characterized by their high use and dependency on technologies [8]. Some researchers go so far as to claim that teaching will eventually only be conducted by technology and multimedia instructional techniques as they are far superior to standard instructional techniques [9].

**Tablet PCs**

The tablet PC, in particular, has become a very common tool in higher education. They are like laptops in the sense that they are portable, but their monitor can be rotated onto the keyboard to act like a slate. This slate in conjunction with the electronic inking stylus can be used to take handwritten notes and make sketches. They afford rich graphics that aid in visualization. The built in speaker and microphone not only enable richer audio presentations, but affords audio recording for future playback. The inking capabilities of the tablet PC provide open-ended note-taking capabilities. There is also tablet PC based software that enables students to create and interact with their learning environment [10].

Many universities such as Pennsylvania State University [11], University of Alaska Anchorage [12], & South Dakota School of Mines & Technology [13] have started to use tablet PCs to teach. The College of Engineering at Virginia Tech started the Tablet PC initiative in 2006, which requires all incoming engineering freshman to purchase and use a tablet PC in class. This study uses the College of Engineering at Virginia Tech as a forum to better understand how the tablet PC is used by different types of learners.

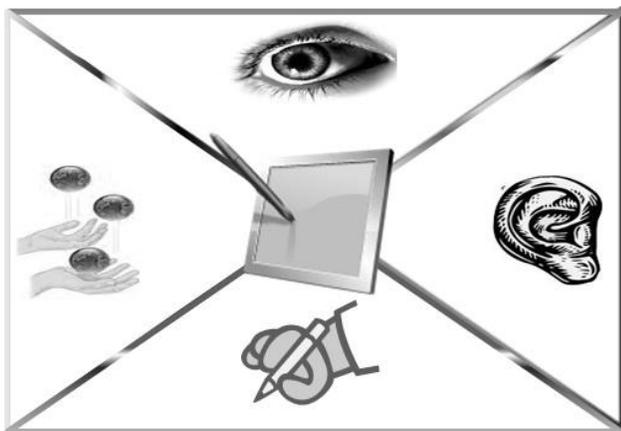


Figure 1: Conceptual model depicting relationship between students' learning styles (VARK Model) and use of tablet PC

In order to better understand how students use the tablet PC, an online survey was sent to all undergraduate students enrolled in the College of Engineering at Virginia Tech after approval by the Institutional Review Board (IRB). The survey obtained a response rate of 18% with a total of 1090 students. All the students surveyed were affected by the tablet PC initiative and were required to purchase a tablet PC for use in the classroom. This questionnaire elicited information on a number of topics, including how they study, organize material, and use the tablet PC, and took approximately 15 minutes to complete.

A total of twenty-seven questions which used a mix of four-point and five-point Likert scales were used in the analysis. Questions prompted the respondents to indicate how frequently they used their tablet PC to engage in different learning behaviors. In addition to the multiple choice items, three open-ended questions that asked respondents about their general use of the tablet PC were used. The first open-ended question asked students what activities were best supported with the tablet PC. The second question asked students what activities did not work well with the tablet PC. Finally, students were asked to share any other experiences or suggestions in relation to tablet PC use for teaching and learning. As Flemings' VARK model served as the theoretical framework for this study's analysis, each of the questions were coded as V, A, R, and/or K. Visual questions were based on students' use of charts and diagrams to better understand course material. Auditory questions related to making use of the tablet's audio recording abilities to record lectures and also discussing the course material with their peers. The reading and writing questions captured the student's use of the tablet's e-inking feature to take and review notes. Kinesthetic questions were based on students' interactivity with the course material. Some questions were coded using multiple modes because it related to multiple modes of learning. For instance "Shared electronic whitespace with other students" was coded as 'V' and 'A' because it involves both visual (through the shared whitespace) and auditory (through discussion) learning modes.

Quantitative responses from the survey were analyzed using descriptive statistics and are shown in Table 1 below. In addition, qualitative responses of the students were analyzed using grounded theory to gain a further understanding of how students with different learning styles used the tablet PC.

**4. RESULTS**

**Descriptive Statistics**

Our results indicate that the tablet PC has been used differently to cater to different learning styles. Highest mean scores were reported in three areas including the visual, reading/writing, and kinesthetic categories of learning styles. These scores included using the electronic ink capabilities of the tablet PC to help illustrate points made in class, creating charts and diagrams, marking slides, and using web-based sources to apply concepts in class.

## Qualitative Analysis

Further detail about tablet PC use in relation to learning styles was provided by the qualitative analysis.

**Visual Learning:** Several students indicated that they used the tablet PC to create visual representations. They reported that it helped with creating diagrams and for sketching assignments. Students also reported that the tablet PCs allowed professors to enhance their teaching experience by adding visual artifacts to their notes. They said, “Used e-ink to write out examples or show drawings and such. Drawings are best supported.”

**Auditory Learning:** Students indicated that they also used classroom software like DyKnow and Microsoft OneNote, which can be used to record lectures, in conjunction with other features of their tablet PC to learn content. According to one student, “Group brainstorming or planning sessions work well with a shared OneNote page.” Another student commented, “DyKnow and OneNote are both just lovely. I am a huge DyKnow fan. I like how the pen strokes can be replayed using DyKnow and the voice recording is a very useful tool as well.”

**Reading/Writing Learning:** A majority of students indicated that the tablet PC was useful for note taking. Tablet PCs were also found to be useful in classes that involved a lot of equation writing. One student reported, “Tablet PC is good for taking notes. Taking notes on the actual slides that a professor is teaching from is much more beneficial than simply taking notes in paper notebook. The tablet is also convenient in that it allows you to take notes without having to print out the lecture slides.”

**Kinesthetic Learning:** Students indicated that the use of interactive classroom software made the class a lot more engaging. Students in particular, reported enjoying taking polls in class. Students also said that the ability to swivel the monitor of a tablet PC helped them to collaborate with each other. Students also liked that they could transfer their drawings and sketches easily using the tablet PC. Students said that, “Activities involving polls and giving responses to the teacher are best supported with the Tablet PC.”

## 5. DISCUSSION

The analyses reveal that the tablet PC can support and provide an added benefit across all learning styles. Features that facilitate visual and reading/writing learning styles were found to be used the most. This can be attributed to the fact that traditional lectures are still the most popular teaching style at Virginia Tech, the location of this study. Lecture-based teaching automatically caters to auditory learners. In the context of this study, the main benefit of using a tablet PC in class is to supplement the lectures with visual and reading/writing artifacts. Reading and writing are natural affordances of the tablet PC due to the ability to easily convert it from a laptop to a slate and use the electronic ink feature with the stylus.

The qualitative analyses further revealed that students use additional features, such as recording the lectures to supplement their learning. These features will also be useful in an online course, where the instructor is remote. Classroom software that make use of the electronic inking capability of the tablet PC like DyKnow [14], which has features like instantaneous polling and slide submission, can be used to make the class more interactive and thus be helpful for kinesthetic learners. Currently, DyKnow is only being used in select classes. If faculty used DyKnow to a greater degree, student responses in relation to this learning style might have been higher.

It is important to acknowledge that the lower mean scores can be attributed to what has also been biggest barrier to the tablet PC initiative at Virginia Tech; the lack of continued and consistent use of the tablet PC by faculty members in all the engineering classes. While tablet PCs have been extensively used in the freshman classes, their use in class by faculty members drop extensively in the senior classes.

One limitation of this study is that the original survey was designed to gain an overall understanding of the use of the tablet PC, but not specifically of the learning styles of the students. We opine that the portability of the tablet PC will also contribute to kinesthetic learning, but this question was not incorporated in this survey. We recommend that questions related to the tablet PC’s size and portability be included in any future studies.

Learning Style	Mean	SD
<b>Visual</b>		
E-ink to create diagrams *	2.16	1.09
Shared electronic whitespace with other students *	1.56	0.83
Helped illustrate points made in class**	3.31	0.95
I made simple charts, diagrams, or tables using the Tablet PC to organize course materials **	2.22	1.23
<b>Auditory</b>		
Shared notes/slides with other students*	1.94	0.98
Shared electronic whitespace with other students *	1.56	0.83
Audio recording of lectures/discussions using OneNote *	1.23	0.59
<b>Reading/Writing</b>		
e-ink to mark slides provided by the instructor *	2.39	1.17
e-ink to take notes using OneNote *	2.30	1.08
Imported web-based information into notes *	2.00	1.10
e-ink to take notes with another program *	1.93	1.06
Special note take capabilities of OneNote *	1.69	0.97
I study by reading my notes over and over again **	2.90	1.24
I make lists of important items for this course and memorize the lists **	2.26	1.18
<b>Kinesthetic</b>		
To respond to interactive class exercises using polling/voting *	1.77	0.88
To respond to interactive in-class exercise using written responses *	1.74	0.91
I try to apply ideas from web-based sources to other class activities such as lecture and discussion **	2.42	1.14
*1= Never; 2 = Rarely; 3 = Occasionally; 4= Frequently		
**1= Strongly Disagree; 2 = Disagree; 3 =Neutral; 4 = Agree; 5= Strongly Agree		

Table 1: Questionnaire Result Means and Standard Deviations

## 6. CONCLUSION

Our results show that the tablet PC can be useful for students who possess any of the VARK learning styles. However, success of tablet PC use in the classroom ultimately depends on efforts to prepare engaging lectures or other engaging teaching styles using the technology [15]. This is apparent in the lower kinesthetic means, which is based on interaction of students in the lecture. These findings can be used by other institutions considering how to incorporate the functionality of the tablet to enrich the educational experience. If instructors do not implement interactive features such as polling and short response questions, kinesthetic learners will be at a disadvantage. The lecture should also be visually engaging and be made available to students in class so that students can read and annotate their notes. Instructors can audio record their lectures using features of the tablet PC and let students access it for future playback. While it is evident that the tablet PC can cater to all learning styles, we envision that they will better support VARK learning styles as instructors as well as students become more comfortable with tablet PCs and their features. If used efficiently, the tablet PC can help the instructor create an engaging learning environment.

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