THE ROLE OF SLATE ENABLED TECHNOLOGY IN COLLABORATION

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Abstract

The use of instructional technologies in the higher education classroom is growing at a rapid pace. More recently, there has been interest in the use of slate enabled devices, such as tablet PCs and iPads, and their impact on engagement and learning. There is also instructional technology software, such as DyKnow Vision, that is designed to facilitate collaborative learning. This paper describes the case study of an engineering course offered during a Summer Bridge Program (i.e., STEP) at a Research I university that was undertaken to examine the role of slate enabled technologies in collaboration between and among course instructors and students. Our results reveal that the degree to which students and faculty used the tablet when collaborating was critically influenced by the instructional software. Due to a tight coupling between instructor-modeled behavior and student behavior, the adoption of the slate technology by the instructor affected the degree to which the students used the technology. In addition, the seating configuration of the students, when working in groups, also affected their collaborative learning experience and engagement.

Introduction

Instructional technologies are widely used to improve classroom dynamics and foster learning. New modes of communication and presenting material through different electronic mediums can encourage interactions and exchanges between and among faculty and students, creating a more engaging learning environment[1]. Recent advancements in slate enabled laptop computers and smaller hand-held devices (e.g., Tablet PCs, iPads, HP Slate 500s), and their impact on collaboration skills among engineering undergraduates is an area in need of further examination. Through a case study of an engineering course offered during a Summer Bridge Program (i.e., STEP) at a Research I university, this research examines the role of slate enabled technologies in collaboration between and among course instructors and students. Our observations are guided by the following factors:

- The degree to which the collaboration is instructor led and student initiated;
- How the instructor models tablet use;
- The degree of student engagement in collaborative activities;
- How and the degree of frequency that students use the tablet flip screen to share ideas, content, and/or notes with peers; and
- Barriers to collaboration and the use of technology in collaboration.

Essentially, we explored the use of the stylus (i.e., e-inking) and other features specific to the tablet PC (i.e., swivel screen) and how those options are used by faculty and students to facilitate collaboration in conjunction with instructional software (e.g., DyKnow Vision).

Background

Collaborative Learning

Collaborative learning is "a *situation* in which *two or more* people *learn* or attempt to learn something *together*"[2]. Within the context of our research, collaborative learning consists of three to five people performing problem solving activities face-to-face. However, there is no guarantee that the desired interactions, which are expected to stimulate learning mechanisms, will actually occur. These desired outcomes

depend on several characteristics such as the instructions to subjects, physical setting, and other institutional constraints in order to characterize collaborative learning situations. More specifically, the group size, gender composition, group proximity to one another (face-to-face or over a network), the degree to which roles and interaction rules are specified, and the degree to which the interaction is regulated either by the instructor or the students can all have an effect on the probability of desired interactions occurring[2].

Collaborative learning is very beneficial to higher education. Through the increased interactions that result from collaborative learning, students become more involved with the course material while developing increased problem solving and critical thinking skills. It also enhances student satisfaction with learning and the classroom experience, which can increase student persistence[3,4]. Essentially, collaborative learning enables students to be active participants in the learning process rather than the passive receivers that tend to result from traditional lecture style courses[3].

Slate Enabled Technology

Slate enabled technology can be divided into two distinct categories with respect to hardware feature: convertible and slate. Convertible technologies such as tablet PCs (Figure 1a), have a similar design to laptop computers with a screen and a keyboard. However, the display can be rotated 360 degrees and folded into "tablet mode" (Figure 1b), enabling the device's screen to become a flat surface. Once in "tablet mode", the image on the display can be positioned in landscape or portrait mode. Users can interact with the device in "tablet mode" with a pen-like device called a stylus. The stylus can be used to select items on the screen like a computer mouse and to write on the screen using natural handwriting. An onscreen keyboard is also included with the software. Another way to interact with the screen in "tablet mode" is with the touch screen functionality; however, this feature is not standard with all tablet PC devices. Other technologies, such as iPads (Figure 1c) and HP Slate 500s, can be considered slate enabled technologies in their purest form. Unlike tablet PCs, these devices do not contain a keyboard. If they do, it is typically a detachable keyboard. They only consist of a flat screen display that afford the same interactions as tablet PCs in "slate mode", via stylus or touch screen, which is much more common in pure slate machines.

The integration of slate enabled technology provides several benefits to learning. Due to the note sharing capabilities of the tablet PC, students reported that their confidence in understanding the course material increased[5]. The tablet PC is often used as a replacement for

Figure 1: (a) Rotated Fujitsu Lifebook T Series tablet PC;
(b) Fujitsu Lifebook T Series in "tablet mode"; (c) iPad.

a whiteboard or overhead projector due to its natural handwriting and annotation capabilities using the stylus[6]. The swivel mode and flat screen surface of slate enabled technologies give all students shared access to the slate screen. This shared focal point provides collaborative teams with a shared focal point that engages all students with the assignment. The flat screen also provides an unobtrusive way for group members to keep up with the assignment while someone is writing (inking) on the screen with the stylus. The integration of slate enabled technology in the classroom has the advantage of facilitating collaboration amongst students and between students and their instructor[7-9]; however, research on slate enabled technology and collaborative learning is limited.

DyKnow Vision

DyKnow Vision [10] (Figure 2) is software that is designed to further extend the capabilities of slate enabled technologies and facilitate collaboration and student interaction in the classroom. It is an interactive teaching tool that can be used to instantly annotate and distribute lecture slides to students where the students can take notes directly on the slides using a stylus to ink on the computer screen, which is the primary mode of interacting with the software. DyKnow Vision notes and recorded audio can also be saved on a central server where students can access and replay them. To further classroom interaction, instructors can check on the degree to which students understand concepts covered in class by sending out a poll. Students can also engage in class by screen sharing or by using the screen broadcasting features. When working on assignments through DyKnow Vision, students are able to submit panels or slides to their instructor for immediate feedback. DyKnow Vision also enables students to interact with the instructor, as well as other students, without interrupting the class through the chat feature[10].

DyKnow Vision contains powerful features to facilitate collaboration (Figure 3). When creating groups, instructors can assign students to groups either randomly or by creating them purposefully through the DyKnow Vision software. The members in these groups can be saved and regenerated to use in future classroom sessions. The DyKnow Vision group feature

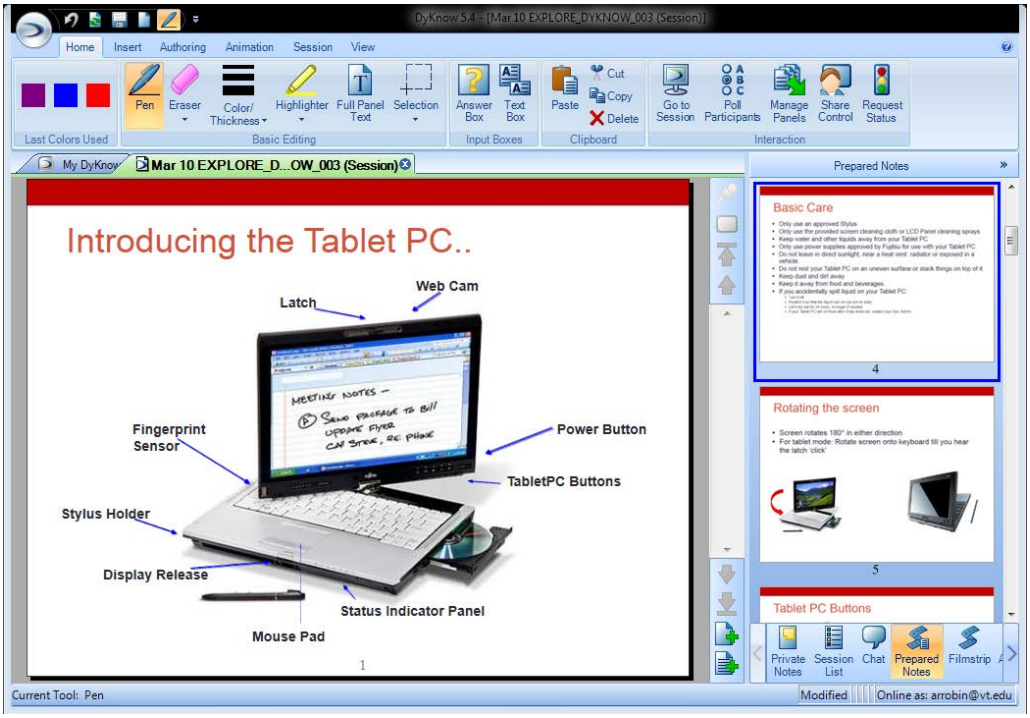

Figure 2: DyKnow Vision Software.

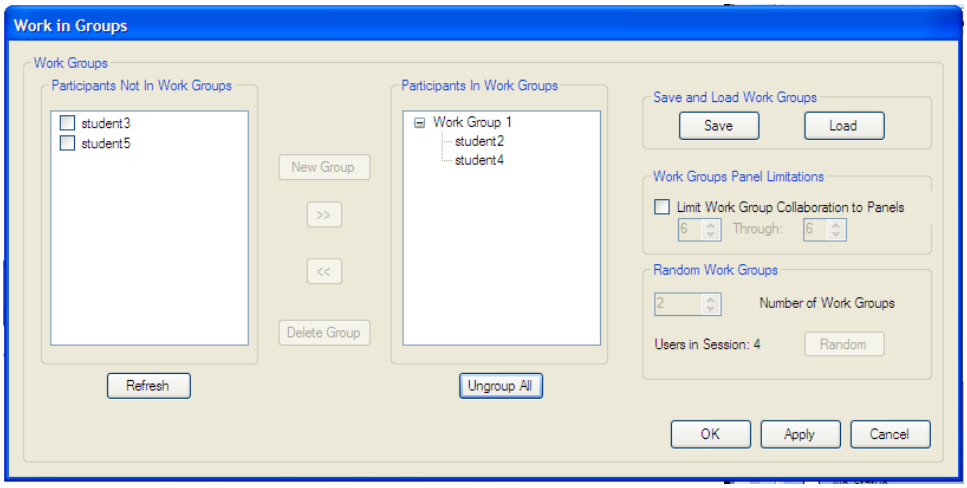

Figure 3: DyKnow Vision Collaboration Admin Panel.

also enables students to share screens with their group members. When group members share screens, they are able to see the DyKnow Vision panels on their own slate enabled devices and are given the ability to annotate the shared panels with their stylus. The annotations appear on the group members' screens. Students in groups can also modify the annotations of their group members using their own devices. This functionality keeps all the group members engaged with the assignment without having to look at the computer screen of another student[10].

While the software and computer capabilities have been designed to facilitate collaboration in an educational setting, there are few studies that examine what factors influence the degree to which these features are used by students and faculty to interact with one another. This case study was undertaken to address the gap in the literature.

Methodology

Weekly observations were conducted in three class sections taught by two instructors. A total of four lessons, over a period of seven class sessions were observed. Prior to the start of classes, both instructors were trained on how to use a tablet PC and the DyKnow software. On the first day of classes, students were trained on how to use the DyKnow software and were provided assistance when needed. The students collaborated and worked on a group assignment provided by the instructor for the last 30 to 45 minutes of class. The groups varied by class section and were either selected by the instructor or based on the existing seating arrangements of the students. Collaborative assignments were completed using Microsoft Word or DyKnow. Due to the tablet PC requirement at the University, all of the students used a Fujitsu Lifebook T Series tablet PC to complete their assignments.

The protocol used during the observations looked at the degree to which the collaboration is instructor led and/or student initiated, how the instructor models tablet use, the degree of student engagement in collaborative activities, and what factors facilitated or impeded the use of slate enabled technology in collaboration. In addition, the protocol also looked at the degree of frequency that students used the tablet flip screen to share ideas, content, and/or notes with peers.

Field notes were taken during each observation. Following data collection, the field notes were reviewed by the research team and coded. Coding was conducted by finding themes in relation to each area of interest in the case study and the notes were grouped accordingly. Once the notes were thoroughly reviewed, we engaged in member checking as a form of

validation by meeting with the lead instructors of the courses that were observed. We asked them to consider whether they experienced or observed anything differently and a consensus was reached by all members[11].

Results and Discussion

Results of the study demonstrate that the tablet can facilitate collaboration, especially when the instructor is trained in how to use the tablet with DyKnow software. Our observations revealed that across class sections, student collaboration was entirely initiated by the instructor through assignments. The course began primarily with a lecture style, with occasional student assessment using polls or screen sharing. Towards the last 30 to 45 minutes of class, the instructor divided the students into groups and gave them instructions for their assignment. Students did not otherwise seek out any type of interaction with other students related to discussing course content.

Student behavior related to collaboration and how they use instructional technology is tightly coupled with instructor-modeled behavior. For instance, if the instructor used the tablet and related features to explain concepts while also providing visual aids (e.g., diagrams, notes) then students were likely to also use these same behaviors in groups to explain concepts to peers.

In terms of the degree of student engagement in collaborative activities, DyKnow proved to be a superior tool in relation to other instructional software. When collaborative assignments are given to students in Microsoft Word, students tend to write on their own digital document or assign one person as the writer, and gather around that person's computer. If students write on their own document, it was observed that the students usually spent more time writing and copying one another's work than they did discussing the assignment. When one person writes and the others gather to look at the writer's screen, there is a greater chance that one or more students will be excluded from the group since the writer's screen may not be easily accessible. When collaborative assignments are integrated into DyKnow and students are placed in groups using DyKnow, students are able to share the screen with their group members. This allows one or multiple people to write, while enabling all members to see the status of the assignment on their own tablet screens. Groups are then able to submit their assignments immediately to the instructor through DyKnow. It is critical that all students are signed into DyKnow; otherwise, they run the risk of being totally excluded.

Results related to the degree of frequency that students used the tablet flip screen to share ideas, content, and/or notes with peers varied. Students sometimes used the tablet flip screen when working in collaborative groups. Using the tablet in slate mode heavily depended on the seating arrangements of the groups. Groups that were seated in a circle were more likely to use their tablets in slate mode for collaboration than groups that were seated in a straight row or groups with members on two different rows. Groups that are randomly created are more likely to sit in a circle than groups that are selected by current seating arrangements. Randomly creating groups using DyKnow worked out because it forced students to get up and move, enabling them to naturally sit in an arrangement that gave all of the members of the group equal access to the assignment and one another.

Students that were in groups where all members were equipped with the tablet often used the tablet for different purposes. For example, they would write on one tablet and use the tablets of the other students in the group as displays for other components of the assignment when the assignment was spread across multiple DyKnow panels or documents (e.g. the directions would be on one screen while someone would write the answer on another Tablet screen). This was done to avoid having to keep switching between panels. In order to accomplish this, all of the group members would put their tablets in slate mode in the center of the circle. Students usually used the

divide and conquer approach when an assignment contained multiple components (e.g. one student would find the formula; another would solve the equation, while the other would plot the points on the graph). If using DyKnow, group members will have access to everyone else's work without having to duplicate it on their own tablets.

Our observations also led to the identification of several barriers to collaboration and the use of technology in collaboration. Student engagement in collaborative activities was heavily dependent on seating arrangements and group size. Groups that were seated in a circle were likely to have more members engaged in the collaborative activity than groups that were seated in a straight row or groups with members on two different rows. Groups with a smaller number of students are more likely to have the entire group engaged than groups with a larger number of students. Groups of four tend to leave out at least one group member while groups of five or more tend to split groups into subgroups (this is also related to seating arrangements).

Conclusion

Findings reveal that instructional software in this study, DyKnow Vision, played a critical role in the ways and degree to which students and faculty used the tablet when collaborating. The slate technology of the tablet PC engaged students in the learning process and empowered them to collaborate and complete assignments in innovative ways. In addition, student behavior related to collaboration and how they employ instructional technology and software is tightly coupled with instructor-modeled behavior.

The results show that students mimic the tablet PC use of their instructors. Therefore, it is recommended that the course lessons and directions provided to students should be integrated with the collaborative technology, primarily relying on DyKnow, rather than using some other means such as Microsoft Word for in-class assignments. Seating arrangements should be taken into consideration when students are working in groups where students sitting in a circular arrangement can have easy access to their group members and their devices. It is also recommended that students in the class have their own slate enabled device so they can have full access and control over the collaborative assignment. The results of this study will be used to train instructors to build the skills needed to gain the most benefit from using slate enabled technologies to facilitate collaborative learning in their classrooms.

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Biographical Information

Ashley Robinson is a computer science Ph.D candidate at Virginia Tech. She is currently the Instructional Technology team lead in the College of Engineering, where she provides faculty and student assistance with tablet PC integration into the higher education classroom. Her research interest investigates the role of human-computer interaction awareness in computer science self-efficacy

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