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BOARD # 31: Work in Progress: Supporting Student Learning with Notetaking in Lectures Based on Visual Communication

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Introduction

In this work-in-progress, we describe our efforts to better understand how to support student learning in the biomedical engineering (BME) major, in which course content is often presented through visual communication such as images or equations. Specifically, we want to learn how to support students as they take notes in courses where material is presented primarily in a visual modality. According to our survey, most students have access primarily to text-based tools to take notes (e.g., writing/drawing with pen and paper or typing text on a laptop). We asked whether there is an equity gap for students without access to devices such as iPads, which allow students to both draw and write text by hand using a stylus.

We are concerned about how diversity, equity, and inclusion (DEI) may be negatively impacted by any differences in student ability to: (1) take notes effectively or (2) afford note-taking devices such as iPads. Any disparity in note-taking ability among groups of students is likely to decrease achievement or engagement, as note-taking is essential for learning and remembering course material as well as being engaged during class [1-2].

The impetus for our work is the student co-author's experience in which she "struggled with catching up in courses since I take notes on paper and cannot afford an electronic notetaking device. After performing poorly in courses such as organic chemistry, which required intensive redrawing of complex structures, in which my peers who took online notes could simply annotate the professor's downloaded slides." The authors decided to learn more about student notetaking practices in classes with substantial visual communication components.

We are concerned that the perceived advantage for students who can afford or otherwise have access to electronic devices, and iPads specifically, creates an equity gap that widens the disparity already experienced by underrepresented students, especially in large introductory courses, which is where many underrepresented students who planned to major in engineering decide to leave the major. BME programs may be particularly susceptible to losing students in prerequisite coursework, as students must take prerequisite courses in the typical pre-engineering areas, such as math and physics, in addition to extensive coursework in chemistry and biology.

Results

We distributed a survey to 85 BME students and received 40 responses, including upper-division students already in our major and lower-division pre-major students who are currently enrolled in an introductory prerequisite course in a different department. Of these, 10 volunteered to share representative examples of their notes, and 4 were randomly selected for visual comparison. The survey consisted of a combination of multiple choice questions (such as choosing between an electronic device or notebook/paper as their preferred method of notetaking) and selecting the subjects that they took notes in (biochemistry, organic chemistry, differential equations, etc.) as well as open-ended questions that invited more student input (description of lecture style in classes, pros and cons of preferred notetaking method). (Note on IRB Status: This study is exempt from a full review because it involves anonymous survey data collected to improve educational practice.)

The survey asked the following questions:

1) How do you take notes in your classes?
2) Why do you use this notetaking method(s)?
3) In which subjects have you used an iPad or electronic device to take notes?
4) In which subjects have you used a physical notebook to take notes?
5) What type of visual note-taking have you done in your classes or research?
6) What courses have you taken in the past 2 quarters, and how have professors presented information in these classes?
7) If you use an electronic device, what challenges have you faced with notetaking?
8) If you use a physical notebook, what challenges have you faced with notetaking?
9) If you do not use an iPad, what are your reasons?
10) If you do not use an iPad and the school provided a free iPad for academic purposes, would you switch to using the iPad for note-taking? Please explain your answer.

In many prerequisite courses, lecture slides often contain only visual information with limited verbal explanation by the instructor. Students report that many courses required for BME (such as chemistry, biology, math, and physics) involve visual-only lecture slides to present important information, and that instructors often prefer to verbally explain the visuals in greater detail rather than annotating the visuals with text. As a result, most lecture slides include only visual depictions such as photos, graphs, figures, and equations. Students report that when a short text description is included on the slide, it may not make sense without proper context, which is provided only verbally (if at all). More detailed information, such as how the visual representations connect to key concepts of the course, is mentioned verbally by the instructor.

The majority of students reported a preference for electronic notetaking. Students perceive that the visual-heavy lecture presentation method works better for students who use iPads because they can simply download the slides before class and then add text or visual annotations in real-time with the instructor. Furthermore, students report that some electronic devices are better than others for annotating visual information. For example, students report that using a stylus on a device such as an iPad is a more efficient way to annotate visuals than typing text with a laptop or phone because with a stylus or touch-screen, students can draw images, hand-write text or images, or type text.

Most students who do not use iPads or electronic devices report that using electronic devices is cost-prohibitive. Most, but not all, students report that they would use an iPad for taking notes if it were provided free of charge. In response to the survey question asking students if they would switch to a different platform for notetaking if they had the means to do so, 78% of respondents who currently take paper notes said they would prefer to take notes on an iPad or other electronic device so that they can listen to the lecture and learn information rather than just copying down information.

For students using pen and paper, the fast-paced delivery of information and the expectation to quickly draw out the diagrams, structures, and equations (that a student with an iPad would already have downloaded) can lead to challenges in keeping up in the lecture and spending more time copying down information rather than understanding concepts.

Some students mentioned disadvantages of electronic notetaking. However, 22% of respondents indicated that taking notes via iPad can be distracting during lecture times due to open access to games and other applications on the device, and would instead prefer professors to either hand-draw complex figures or provide more time in class to draw them out. Many of these students choose to handwrite their notes.

Studies have shown that notes by hand promotes deeper cognitive processing in comparison to typing, as well as helps with long-term retention and recall of information [2]. While an iPad may allow for stylus-based handwriting and mimic writing on paper, there is still a lack of spatial cues that paper note-taking allows [6]. In addition, students remember more information when using paper notebooks than tablets because of the higher physical and spatial engagement with paper.

Future Work

Alternative strategies that instructors can take to promote the success of students who may not have access to an iPad include providing slides in advance, pausing for drawing time during lecture, hand-sketching complex figures during the lecture, or involving pre-note assignments [7,8].

We will meet with BME faculty and identify methods to make teaching styles easier for those who take handwritten notes, or finding a way to introduce a device program to the BME department for academic purposes. For example, the Device Enrollment Program (DEP) is offered through UC Santa Cruz IT Services and allows students to buy or loan an iPad while they are enrolled in courses. The Science and Engineering Library also offers laptops to use for short periods of time.

Conclusion

We share the preliminary results of a survey of 40 undergraduate students on notetaking. Students perceive an advantage to taking notes electronically and report the benefits of being able to download visual-heavy slides before lecture and then annotate during class. The majority of students reported that they would use an iPad or other electronic device if the cost were not prohibitive. Our survey results help us identify accessibility concerns in notetaking for lecture content composed primarily of visual communication. Ensuring that all students have equitable access to notetaking resources is essential to creating inclusive learning environments, and we are exploring (1) resources to help students afford electronic devices and (2) alternative teaching strategies to support students who do not use electronic devices for notetaking.

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