UNPLUGGING STUDENTS: UTILIZING GUIDED TECHNOLOGY POLICIES TO ENHANCE CLASSROOM ENGAGEMENT

Darien A. Hall, Grand Canyon University
Mark Wireman, Grand Canyon University

ABSTRACT

The utilization of in-class technology to enhance student learning and increase topic engagement, such as audience response systems, is well-documented. Unfortunately, freely available personal technology such as cell phones and laptops can also act as distractions that reduce learning effectiveness. In this study, which was undertaken just prior to the COVID-19 pandemic, we implemented a guided technology policy that limited access to personal devices in introductory undergraduate anatomy and physiology courses to determine the effect on in-class perception of student engagement and student performance. We utilized grades and surveys to examine the relationship between technology use, achievement, and student perception of the guided technology policy. The results demonstrated that while students in the guided technology class sections of the study all reported a significant increase in feelings of engagement and increased levels of attention paid to the instructor, there was no increase in grades compared to students whose classes allowed free technology use. Thus, while a disconnect was found between perception and achievement, it is clear that selective integration of classroom technology can be beneficial in promoting engagement.

Keywords: engagement, technology, undergraduate, success

INTRODUCTION

The introduction of technology has both positive and negative outcomes in higher education classrooms. Not all technology has a place in the classroom since not all of it improves the educational experience. It is even more important now, in the wake of a pandemic that pushed the world to a new level of technological integration, to understand how specific technology affects student learning. Technology can be broadly defined as any scientific knowledge applied for practical purposes, which could include everything from interactive smart boards with direct internet connections to ink pens. In this study we explored how free access to digital technology, such as laptops, tablets, and phones, compared to guided access in regard to student achievement and their perception of learning. We utilized the first and second semesters of undergraduate anatomy and physiology for this study. These courses are considered "gatekeeper" courses and have high withdrawal and failure rates (Hopper, 2011). Improving student outcomes and perceptions of learning would be particularly beneficial for courses that fall into this category.

BENEFITS/RISKS OF TECHNOLOGY IN THE CLASSROOM

Multiple studies have demonstrated the benefits of integrating technology in higher education classrooms. One technology in particular, audience response systems (ARSs), have been extremely successful in promoting learning and engagement.

There are many types of ARSs, but they all have the same fundamental components: a piece of hardware (such as a cell phones, laptop, or clicker) that allows the user to connect with software so the instructor can interact with the student audience. Most commonly these devices are used for formative assessment, which is related to improved performance on summative assessment, but they can also be utilized for summative assessment. (McKenzie & Ziemann, 2020; Schmidt et al., 2020). When ARS usage is linked to a portion of the student's final grade it results in increased attendance, and increased attendance is closely linked to the final course grade (Kay & LeSage, 2009). Using an ARS increases active learning in the lectures (Kay & LeSage, 2009), and students report feeling more positive emotions over traditional hand-raising techniques (Stowell & Nelson, 2007). Overall, the incorporation of ARS is strongly related to increased student performance as well as increased student perception and enjoyment of learning.

OTHER TECHNOLOGY THAT BENEFITS THE CLASSROOM

When carefully tailored, videos can assist in explaining complex subject matter and increase student engagement with the material (Brame, 2016). Internet access via personal devices, such as laptops, tablets, and cell phones, allow students immediate access to a greater variety of relevant, recent course materials (Kool et al., 2010). Aside from course materials, students also have increased access to research materials that can help with problem-based learning (Kay & Lauricella, 2014). Personal device usage in certain classes also increases peer-to-peer collaboration, and students report feeling that laptop usage in the classroom improves learning (Kay & Lauricella, 2014). Lastly, during COVID-19 related lockdowns, many classrooms became entirely dependent upon technology by necessity. With millions of students forced into remote learning, video-conferencing tools like Zoom, Microsoft Teams, and Skype allowed education to continue.

In contrast, technology does not always have a benefit and can detract from learning when used incorrectly. There are many studies outlining how technology in the classroom can be a distraction from learning. Cell phone use has been linked to decreased scores such that greater text message frequency by a student is negatively correlated with grade point average (Harman & Sato, 2011). Despite the student perception that laptops increase learning, laptop usage is also negatively correlated with grade point average (Lepp et al., 2015). Laptop usage has also been shown to distract others within the viewing area of the user (Sana et al., 2013), and thus can be harmful not only to the student who owns the device but also those around them. While students may be able to type faster than they can handwrite their notes (Brown, 1988), the students miss out on the analysis of the content through the process of verbatim notetaking via typing (Smoker et al., 2009). Longhand notetaking, rather than laptop usage, has been positively correlated with increased scores on conceptual questions (Mueller & Oppenheimer, 2014). The theory underlying this discrepancy is that greater cognitive resources are required for paraphrasing into notes, which thus increases retention.

Research Questions

The focus of this study is how personal technology use affects the interactions within a classroom and student learning. With the recent implementation of online remote lecturing during the pandemic, technology has taken the main stage in instruction. However, research has demonstrated that feelings of engagement declined during the pandemic in STEM students (Wester et al., 2021). This decrease in student engagement is alarming since student engagement it is strongly correlated with achievement (Casuso-Holgado et al., 2013; Kahu & Nelson, 2018) and increases student understanding (Nagro et al., 2018). Hence, there is a need to understand how technology shapes student achievement and perception of learning. We examined two main research questions by limiting the use of personal technology in our classrooms while still utilizing an ARS to drive engagement.

RQ 1: Does limiting personal technology in the classroom increase student achievement?

RQ 2: Is student perception of engagement altered by limiting classroom technology?

METHODS

Overview

In this study, there was both a quantitative analysis of achievement and student perception and a qualitative component examining student testimony regarding the policy. We implemented a

guided technology policy in half of our anatomy and physiology class sections in the Fall 2018 and Spring 2019. This included both the first and second semesters of anatomy and physiology. We were unable to control which students enrolled in each course, so the second semester courses had a mixture of students, some of whom had, and some who had not, taken the previous guided technology class.

Participants

This study was completed at private Christian university in the southwestern region of the United States. Total student population (n = 592) was primarily prenursing majors with a smaller percentage of athletic training majors. Class size was variable, between 40 and 90 students, with an average distribution of approximately 90% female and 5–10% male depending on the class section. This male to female distribution is important to note since there are indications that gender differences exist in student response to the active-learning classroom. Specifically, males in STEM fields are more likely to engage and benefit from engagement via active learning in the classroom (Aguillon et al., 2020). Unfortunately, the number of males was too small for adequate statistical comparison to determine if gender differences persisted in this study as well.

Guided Technology Policy

In the class sections that implemented the guided technology policy, we required that all technology be put away at the beginning of class and only retrieved by the students when instructed to do so. This included all laptops, tablets, cell phones, and smart watches. Students were instructed to take notes by hand, and exceptions were made for students with university approved disability accommodations. In the classes where no guided technology policy was implemented, we provided no instruction on technology usage and students were allowed free access to their devices throughout the class. Aside from this distinction, the classes were as close to identical as possible utilizing the same textbook, objectives, topic order, and exam structure.

Audience Response System Utilization

In the guided technology classes, students were only allowed to access their personal devices when instructed to do so for interacting with the ARS. Whether students were in the free access or guided technology policy classrooms, both utilized the same ARS at the same intervals. The two ARSs employed were primarily Kahoot and, to a lesser extent, Poll Everywhere. Both can be used for formative assessment, which allows the instructors to capture immediate, relevant feedback, and provides students with immediate feedback on their understanding and progress. Kahoot is a game-based quiz platform that allows instructors to create multiple-choice, timed assessments. Additionally, once a quiz question ends, the percentage of the class that chose each answer is displayed, as well a "podium" displaying which students were the top three players for each round. Poll Everywhere also allows for creation of multiple-choice quizzes, but it is not competitive and lacks a timer, though it does provide a real-time display of which answer the students are choosing. Additionally, Poll Everywhere allows for longer question prompts and answers.

The ARSs were generally utilized at two to three points during the class period: Once at the beginning of a class session to review the previous class's material, occasionally in the middle of the lecture to check for understanding on new material, and then again at the end of the class to allow students to briefly review the topics covered that day. The type of questions and their length varied from topic to topic, and the ARS was not utilized on days in which summative assessments in the form of multiple-choice exams occurred. Both types of ARS could be accessed via tablet, cell phone, or laptop. Accessibility was an important factor in choosing the ARS since not all students owned a tablet or laptop; however, all students owned internet-capable cell phones.

Data Collection

Data were collected from two sources: surveys and grades. The surveys were administered utilizing both Likert and non-Likert scale questions, as well as open-ended opinion questions, about student perceptions of the guided technology policy. We created the survey questions with a focus on obtaining the student perspective. Final grades as a percentage were utilized as a measurement of achievement. Statistical analysis of achievement occurred via multiple comparisons one-way ANOVAs.

RESULTS

Student Achievement

Student achievement was analyzed following

both the first and second semesters with a comparison of final grades as a percentage. As can be observed in Figure 1, no difference was found between either the guided technology policy classes and free access classes for the first semester (mean 74.19 and 76.49 respectively, $p = 0.460$) or the second semester (mean 79.75 and 83.35 respectively, $p = 0.737$). Since performance on the first exam may be a more sensitive test of student achievement, those scores were also examined and no difference was found (data not shown). Lastly, we performed correlational analysis between final grades and the responses to the Likert scale questions (shown in Table 2) to determine if grades and perception of the guided technology policy were interrelated, and again there were no significant findings (data not shown). Consequently, it can be concluded that student achievement was unaffected by a guided technology policy in this experiment.

Student Survey Results

The surveys were given to the students at the end of the second semester in the guided technology classes. Non-Likert questions and their percentage of responses can be observed in Table 1, with 90% of the students reporting that they enjoyed taking notes by hand and 86% of the students responding that they would consider taking notes by hand in other classes where technology was permitted. The responses to these two questions indicate that students found note-taking by hand to be of greater benefit than typing them into a tablet or laptop.

Figure 1. Comparison of Final Grades

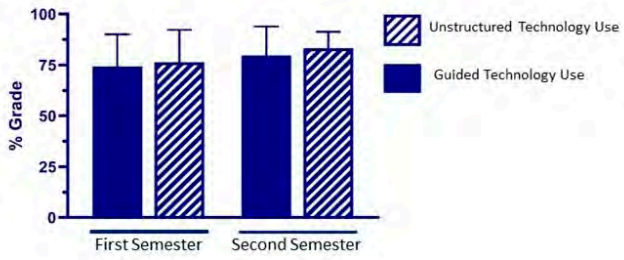

Table 1. Non-Likert-Style Questions *N=107*

Question	Percent Responding Yes	No
Did you like taking notes by hand?	90	10
Would you consider taking notes by hand in other classes where technology was permitted?	86	14

Table 2. Likert-Style Questions *N=107*

	Percent Responding Strongly Disagree		Neutral		Strongly Agree
Question	1	2	3	4	5
I would take another guided technology class in the future.	6	6	22	34	33
I liked the guided technology format in the class.	6	9	18	34	33
The guided technology format improved my grade in this class.	7	10	32	27	23
Personal technology (i.e. phone, laptop) is a distraction in class.	4	17	29	29	25
The guided-tech format improved my ability to remember information presented in class.	4	8	27	33	28
I felt more engaged in this class compared to classes where technology is permitted.	1	11	16	31	41
I paid more attention to the instructor in this class compared to classes where technology is permitted.	1	13	17	31	45

The Likert scale questions with their percentage of responses can be seen in Table 2. Compared to classes where technology usage was unrestricted, 72% of the students either *"agreed or strongly agree"* that they felt more engaged and felt like they paid greater attention in the guided technology classes. Additionally, 66% reported that they *"agreed or strongly agreed"* that they liked the guided technology format and would take another guided technology class in the future if the choice was available. Furthermore, 61% of students reporting "*agreeing or strongly agreeing*" that the format improved their ability to remember the information. However, fewer students reported feeling like the policy improved their grades, with only 50% *"agreed or strongly agreed"*. Overall, these results indicate that students felt there was value in restricting technology and would like to transfer this experience to other courses, but their perception of the effect the policy had on their grade was generally in line with the quantitative analysis of achievement.

Despite the perceived benefits of increased feelings of engagement and improved retention, only 55% of the students *"agreed or strongly agreed"* with the statement that "Personal technology is a distraction in class." This decrease in the percentage of students who felt that technology was distracting, compared to those who felt there was value in restricting it, suggests that while many students appreciated the policy, some may not have grasped the relationship between perception of learning and the distraction that access to personal technology creates.

It should be noted that the data collected in this study was prior to the COVID-19 pandemic, which allowed us the freedom to implement a stricter guided technology policy. With students experiencing a more technology heavy format during a pandemic that required the use of Zoom, Microsoft Teams, and Skype, further research may be conducted to evaluate students' experience and satisfaction following the return to face-to-face instruction. Limiting personal technology access may help students return to pre-COVID-19 levels of engagement.

Sample quotes from the open-ended portion of the survey are presented in Table 3.

These were chosen as being representative and a reflection of the most common general attitudes. The majority of open-ended answers were positive in tone, and they reflected the results from the Likert-scale questions. Students related that they felt increased levels of engagement and fewer distractions from technology. However, the negative responses revealed why some students did not find the restricted access beneficial. The most common negative statement indicated that the students felt they should not have their access controlled since they were adults, and they should be free to make their own choices regarding their personal technology (see sample answer 4 in Table 3). A small number of students reported that hand-writing notes was less efficient than typing as they felt unable to keep up with the pace of the class (see sample answer 5 in Table 3).

DISCUSSION

General Discussion

The results of the data analysis surprised us. We initially predicted that a guided technology policy would increase student in-class engagement, which would translate to an increase in student achievement. No difference in student performance was detected regardless of the presence of a guided technology policy in this experiment so, Research

Table 3. Open-Ended Question Sample Responses

Question: How did you feel about the guided technology policy in class?

Response	Positive
1	"I was more focused on the the class and obtained information, more than slacking off on my phone."
2	"At first it was hard, but in the end it was helpful and helped me focus."
3	"In the beginning of the semester I did not like the policy because I am better at taking notes on my computer. But having "no tech" helped me to be more engaged in lecture and take proficient notes in a timely manner."
	Negative
4	"I didn't think it was necessary. I think, as adults, we should be able to determine and decide for ourselves if tech is distracting."
5	"I did not like it because I could not follow along on the PowerPoints and I feel I would have had more success if I was able to."

Question 1 was not supported. However, there is more to classifying a class's success than just summative scores. The survey findings here revealed that students felt more engaged, with the majority reporting that they felt increased satisfaction with the format of the class due to limiting technology use. Therefore, Research Question 2 was supported.

Despite many studies correlating feelings of engagement with achievement (Casuso-Holgado et al., 2013; Kahu & Nelson, 2018), our study is not the first to report a disconnect between perception of engagement and achievement. When students in an active learning classroom were compared to a standard passive lecture classroom, undergraduate STEM students in an introductory physics course reported greater feelings of engagement in the standard class, but the active learning sections reported higher grades but lower feelings of engagement (Delauriers et al., 2019).

Lastly, students did relate an appreciation of taking handwritten notes. This may translate into a long-term benefit of continuing that form of engagement in future classes. Interestingly, even with many students reporting an increase in class engagement and satisfaction, only 55% of the students felt that technology in the classroom was distracting. Since no correlation existed between achievement and self-reported satisfaction with the course, it can be assumed that students across all achievement levels found the restrictions useful but possibly not necessary. Perhaps those who do not feel that technology is a distraction are more likely to either have better control of their own use of it and therefore see no need for the limitations. Alternatively, some students may find the removal of the technology invasive, and since it is such an integral part of their lives, losing access to it for even an 80-minute time-period is distressing. Further questions would need to be included on the survey to determine which of these two competing theories is more accurate.

Limitations

One limitation of the study was the timeframe of when the surveys were administered during the experiment. The surveys were not administered until the end of the second semester of anatomy and physiology. Since this was a freshman level course, the surveys were delayed until the end to ensure that students had time to experience multiple college courses with different technology expectations. Administering the surveys at the end of the first semester, or even after the first exam, may give greater insight into the impact of the guided technology policy on learning.

A second limitation was the length of the study. As was mentioned previously, while RQ 1 was unsupported, RQ 2 was supported with students consistently reporting that the guided technology policy was beneficial. One important question remains regarding achievement and guided technology policies, and that is whether retention of the material past the end of the course is increased. While final grades may not have been affected in this study, it is unknown if the increased feelings of engagement and learning translate into a longer-term benefit of increased retention of material. Thus, a follow up assessment a semester later may provide insight into this question.

CONCLUSION

Since anatomy and physiology is often perceived as a "gatekeeper" class with high failure and withdrawal rates, identifying tools and policies to increase achievement is important (Hopper, 2011). In the study presented here, we found that restricting access to personal technology during class time increased student perception of engagement and learning. These feelings may lead to the students altering their behavior and utilizing handwritten notes over typing in future courses. This habit may improve performance in future classes, but the policy did not increase student achievement in the current class, which was one of the goals of the study.

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