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Students' Natural Use of Technologies in Classroom Lectures

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An Introduction to ATINER's Conference Paper Series

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Abstract

Students' self-reported use of technologies was assessed through two short surveys. In the first survey, a qualitative analysis of student responses (n = 130) to an open-ended question, asking them about technology use in the classroom, yielded themes that depicted considerable variety in the technology based distracting activities students engaged in during lectures. A small minority (4.9%) of the second year students in this sample reported never using any technologies during lectures. In addition, some students reported that they usually prefer to write paper notes, but do occasionally engage in texting. Although a large proportion of students reported using laptops for taking notes (39.2%), interestingly, most of these students also used their laptops for other, distracting activities. Overall, students most often reported engaging in texting, using Facebook™ and MSN. Similar results were also obtained in a second survey where 389 introductory students were asked to identify the technologies they would be most likely to use in a classroom lecture, if they were to use any. The most commonly reported activities included using: Facebook™, texting, and email. In addition, within this sample, age negatively predicted likelihood of multitasking using digital technologies in a classroom. Students' frequent use of technologies for distracting purposes has implications for their learning outcomes. The results of this study also have implications for educational policy and educational initiatives, known as Anywhere Anytime Learning initiatives, which promote the use of digital technologies to maximize learning opportunities.

Keywords: classroom lecture, digital devices, distracting, multitasking, productive

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The use of digital devices that provide wireless connection to the Internet, such as computers, cell-phones, and smart-phones, has already become the norm in education (Weaver & Nilson, 2005). In addition, research suggests that while the use of school computers is decreasing, use of personal digital devices for educational purposes is increasing (Jerald & Orlovsky, 1999; Meyer, 2001). This increased use might be at least partially due to the expanding functions of such devices, especially smart-phones, which have progressed from call-only functions to texting, Internet access, emailing, multimedia services, and the ability to download helpful applications (Lefebvre, 2009). The increased popularity and versatility of these devices increases their potential as educational tools that can be utilized by teachers and educators (Liu, 2007; Motiwalla, 2007).

The use of digital devices can lead to positive learning outcomes, and support self-regulated learning (Mueller, Wood & De Pasquale, submitted). Previous research suggests that successful learners are those who engage in self-regulated learning (Paris & Paris, 2001; Zimmerman, 2002). Self-regulated learners have been shown to be intrinsically motivated to learn, possess high domain knowledge, utilize metacognitive skills for monitoring their behaviour and performance, set goals, and flexibly utilize and coordinate a variety of sophisticated learning strategies (e.g. Willoughby, Wood & Khan, 1994). Therefore, having access to a digital device that allows learners to search for, access, and organize information in a free and flexible manner has the potential to improve learning. Consistent with cognitive load theory (Sweller, 1988; Sweller & Chandler, 1994), a well established theory of instructional design (Ozcinar, 2009), learning can be improved for advanced learners who have high domain knowledge, when the learners can exert control over their own learning (e.g. Kalyuga, 2007).

Many educators and schools encourage the use of digital devices with some mandating the use of devices, such as laptops (Weaver & Nilson, 2005). These devices are perceived to supplement traditional teaching and learning tools as part of Anywhere Anytime Learning (AAL) initiatives (Milrad & Spikol, 2007). However, the effectiveness of technology use in educational contexts has not been thoroughly studied, and the extant research shows mixed results (Weiner et al., 2008).

Several factors seem to mediate the effectiveness of technology use for student learning outcomes. These factors include successful integration of technology into lectures (Weiner et al., 2008), ability to successfully overcome practical, technological, and pedagogical barriers of technology use in learning contexts (Weaver & Nilson, 2005; Wood, Mueller, Willoughby, Specht & DeYoung, 2005; Wood, Specht, Willoughby & Mueller, 2008), and the type of technology use (Kraushaar & Novak, 2010). The remainder of this paper will focus on type of technology use.

Kraushaar and Novak (2010) identified two types of technology use: productive and distracting. Research shows that productive behaviour can greatly improve one's learning experience in a multitude of ways. Specifically, research shows that using technology for productive behaviours in a learning contexts serves to motivate students, encourage persistence on a challenging task, and personalize the learning

environment to the learner's personal needs (e.g. Gee, 2009; Looi et al., 2009; Specht, 2010; Specht, Howell & Young, 2007). In addition, productive use of technology has been shown to increase student attention and interest in learning (Lowther, Ross & Morrison, 2003), facilitation of learning, integration and application of knowledge to other context/classes, and processing material in deeper and more meaningful ways (Lowerison, Sclater, Schmid & Abrami, 2006). Moreover, using technology in lectures can also lead to enhancements in student-centered, hands-on and exploratory learning, improved student-to-instructor interactions, and collaborative student interactions (Barak, Lipson & Lerman, 2006). The improvements in collaborative group learning, as a result of technology use is a well-supported finding (e.g. Lowerison et al., 2006; Lowther et al., 2003). Most importantly, using technology for productive behaviour can lead to significant improvements in achievement, such as receiving higher grades (Lowerison et al., 2001).

However, research shows that when students have technology available for productive purposes, they also engage in distracting behaviours (e.g. Fried, 2008; Lowther et al., 2003), even when they are explicitly instructed not to (Wood et al., 2012). More importantly, using technology for distracting behaviours has consistently been shown to have a detrimental impact on learning, including challenges in understanding course material (Fried, 2008), inability to flexibly apply information to novel contexts (Foerde, Knowlton & Poldrack, 2006), and lower grades (e.g. Hembrooke & Gay, 2003; Wood et al., 2012). A recent exploratory study conducted to determine the effects of ubiquitous computing, part of the Anywhere Anytime Learning initiative, showed that when students had laptops available for productive purposes, they frequently used them for distracting activities (Wurst, Smarkola & Gaffney, 2008). Seventy-eight percent of students reported that they found laptops in the class to be a distraction. In addition, these students reported that the temptation to use the Internet was too difficult to resist, and that the physical structure of laptops was not conducive to learning, due to glare from the computer screens and unfavourable seating arrangements (Wurst et al., 2008). Moreover, students who used laptops in class reported significantly less satisfaction with their education compared to those students who did not use laptops in class (Wurst et al., 2008). One reason for the decrease in students' reported satisfaction may be that not all students possess the technological and computer skills necessary to effectively use computers for learning purposes (Rivera & Rice, 2002). However, this reasoning may not apply to younger generations of students who can be considered digital natives (Prensky, 2001), and who posses high technological skills, and comfort levels with technology use (Zivcakova, 2011). Overall, however, the results of this current research indicate that using laptops in classroom produces no significant improvements in achievement compared with traditional non laptop methods (Wurst et al., 2008).

An older study by Grace-Martin and Gay (2001) examined the impact of Internet browsing activities on student grades. Similar to the Wurst et al. (2008) study, students in this study received laptop computers for educational purposes at school and home. The researchers recorded students' web browsing, including URL's, length of use, dates and times, and their final grades. The results of this study revealed a

significant negative correlation between length of browsing sessions and final grades, indicating that longer web-browsing sessions are associated with lower grades (Grace-Martin & Gay, 2001). These findings are supported by a more recent study conducted by Kraushaar and Novak (2010), which found that, on average, students opened 65 active windows, of which 62% were utilized for distracting purposes. Not surprisingly, the researchers again found significant negative correlations between web-browsing activities and student grades. Moreover, the researchers found that students frequently underreported the frequency of their emailing and instant-messaging activities (Kraushaar & Novak, 2010). However, both of these studies drew upon correlational data, making it challenging to make cause-and-effect inferences.

Few experimental studies examining the impact of distracting technology use on learning have been conducted. In one study, students were randomly assigned into one of two conditions, laptop use during lecture, and no laptop use (Hembrooke & Gay, 2003). While all participants had a laptop during the lecture, those in the laptop use condition were allowed to use their laptops as a supplement to their learning during the lecture. Participants in the no laptop condition were instructed to close their laptops for the duration of the lecture. After the lecture, all participants completed a surprise quiz composed of recognition and recall questions. The results indicated that participants in the no laptop group significantly outperformed the participants in the laptop use condition on the memory task (Hembrooke & Gay, 2003).

In another experimental study, participants were randomly assigned to one of 7 conditions (Wood et al., 2012). There were four distracting experimental conditions (Facebook™, texting, email, and MSN), and three control conditions. Two of the control conditions were productive controls (paper notes only, and word processing notes only), and one was a natural use control condition, in which participants were allowed to use technology, if they chose to do so, in a way they would normally use technology in a lecture classroom. All participants participated in three consecutive lectures. After each lecture, the participants completed a brief recognition quiz, which tested their memory of the content material presented in the lecture. Participants also completed a fidelity measure, in which they indicated exactly what activities they engaged in during the lectures. The results revealed that across the three lectures, only the participants in the MSN and Facebook™ conditions scored significantly lower on the memory quiz than participants in the paper notes control. In addition, contrary to prediction, there were no systematic improvements or practice effects, in memory performance across the three lectures. However, the results from the fidelity measures indicated that a large portion of the participants (43%) self-reported not adhering to instructions, and using additional technologies. For this reason, based on the information provided in the fidelity measures, participants were divided into technology users and technology non-users. The results revealed that technology non-users significantly outperformed technology users on the memory quiz. Next, the amount of multitasking was examined. For this purpose, participants were divided into 4 categories: non multitaskers, low, medium, and high multitaskers. The results indicated that non multitaskers outperformed all levels of multitaskers, and

participants in any of the multitasking categories did not differ from each other. This finding suggests that engaging in even low levels of distracting use of technology during a lecture has a detrimental impact on learning (Wood et al., 2012). This last finding is contrary to that of previous studies (Grace-Martin & Gay, 2001; Kraushaar & Novak, 2010), which found that the more distracting multitasking, or the longer the distracting multitasking sessions were, the lower the students' grades tended to be.

Overall, the pattern across studies suggests that engaging in distracting multitasking activities during classroom lectures has a detrimental impact on student learning. However, in order to be able to assess the magnitude of the negative impact of students' distracting use of technologies, we need to determine the level of distracting activities that the students naturally engage in during classroom lectures. This issue of ecological validity is an important one to consider, especially given the risk that in much of the existing literature, the novelty of participating in a research study could have systematically affected the research outcomes. For example, the novelty of having been assigned laptop computers, or being encouraged to bring mobile technologies to class (e.g. Grace-Martin & Gay, 2001; Wood et al., 2012; Wurst et al., 2008), may have inflated students' use of the technologies. The aim of the current study, therefore, was to explore students' natural use of digital technologies for distracting and productive behaviours in real classroom lectures. Given the exploratory nature of the current study, specific predictions about the potential outcomes were not made.

Method

Participants

Two separate participant samples were utilized in this study. The first sample included 130 undergraduate students (21 male, 109 female: M_{age} = 19.67, SD = 1.39), who were enrolled in 2nd year research methods and statistics courses. The second sample included 389 undergraduate students (M_{age} = 18.58, SD = 8.38) enrolled in an introductory psychology course. Of these participants, 134 were male, 254 were female, and 1 participant self-identified as other. Using a one-sample t-test, the results indicated that the mean age of the participants in the two samples differed significantly,
$t_{(388)}$ = -2.570, $p < .05$. All participants received course credit as compensation for their participation. In addition, all participants were treated in accordance with the guidelines of ethical treatment, as outlined by APA/CPA.

Materials and Procedure

Two brief survey measures were utilized for the purposes of the current study.
The first survey was composed of two demographic questions regarding participants' age and gender, and an open-ended question, which asked students to '*Please*

describe your usual use of technologies in a lecture classroom.' The first sample of participants completed this survey.

The second survey was designed as a follow-up to the first survey, and it was comprised of 4 questions. The first two questions inquired about the students' age and gender. The third question asked students to indicate the top 3 activities, from a list of 18 activities, they would be most likely to engage in during lectures, even if the activities were not part of the instruction. The last question asked participants to indicate on a 7-point Likert-type scale (1 = *Never*, 4 = *Sometimes*, 7 = *Always*), how likely they were to perform the top 3 activities in any given lecture. The second sample of participants completed the second survey.

Results and Discussion

Qualitative Data

The qualitative data from the first survey were analyzed using an inductive coding technique (Strauss & Corbin, 1990). Emerging themes or categories of technology use were recorded as responses were read, and where applicable, similar responses were grouped under more abstract headings (Sahin, 2003). To ensure reliability of the coding scheme, an explicit code of theme labels, definitions, and examples (Boyatzis, 1998) was developed. Two raters coded approximately 25% of the responses with a high inter-rater reliability (97.32%). Discrepancies were resolved through discussion between the two raters (Boyatzis, 1998). A single rater coded the remaining responses.

Given the open ended nature of the question, the content of participant responses varied widely. Overall, preferences for technology use fell into three general categories: use of technology for distracting purposes, technology use for strictly productive purposes, and no technology use. Specifically, a large proportion of participants indicated that they normally use technology for distracting multitasking purposes during lectures (73.8%). A smaller proportion of participants (9.3%) indicated that they use technology strictly for taking notes, or other productive purposes, and do not engage in technology use for distracting behaviours. Lastly, 12% of students indicated that they generally prefer not to use any technologies during class, but do so on a rare occasion, and an additional 4.9% indicated that they never use any technologies in any classes. According to student explanations, their technology use is dependent mostly on the difficulty level of the lecture content material, as well as class size, with more technology use occurring in larger classes. Although these results revealed a high level of distracting multitasking, previous research implies that students frequently underreport their levels of distracting multitasking (Kraushaar & Novak, 2010). Therefore, actual levels of distracting multitasking might be even higher.

Technology Use and Note-Taking Preferences

For those students who explicitly described their note-taking preferences (52% of the overall sample), the results are as follows: A large majority of these participants (75%) prefer to type their notes. Moreover, of these 75% of laptop note takers, 23.5% use their laptops strictly for note taking purposes, while the remaining 76.5% of laptop note-takers use their laptops to engage in distracting multitasking behaviours as well. This result may indicate that having technology available for productive purposes predisposes students to use that technology to engage in distracting behaviours, as was found in previous research (Wurst et al., 2008).

In addition, 25% of the students who indicated their note taking preferences reported that they prefer to write their notes on paper; however, they also use their cell-phones to engage in distracting behaviours, mostly texting or Internet browsing.

Amount and Types of Multitasking Activities/Technologies

As mentioned above, 73.8% of participants reported using technology for distracting purposes. Once again, the types of technologies used/activities engaged in, as well as the amount of multitasking activities performed by these students varied greatly. The following results, presented as percentages, reflect how many students reported engaging in specific types of activities. Given the multiple activities/technologies listed by some participants, these percentages do not add up to 100%.

The most frequent activities the participants reported engaging in during classroom lectures are: texting (75%), Internet browsing for entertainment purposes (19.8%), using Facebook™ (18.8%), MSN messaging (14.6%), emailing (8.3%), and playing games (8.3%). In addition, students reported engaging in 1 to 5 distracting multitasking activities during classroom lectures, with a mean of $M = 1.48$ activities. Specifically, 62.5% of people reported engaging in a single multitasking activity. These students would be considered low multitaskers. Twenty-six percent of participants were medium multitaskers, engaging in 2 multitasking activities, while 11.5% of participants were high multitaskers, normally engaging in 3 to 5 multitasking activities. This result is important given that previous research has shown that engaging in as little as one multitasking activity during a lecture classroom, regardless of type, significantly detracts from learning (Wood et al., 2012).

Quantitative Data

The quantitative data from the second survey were analyzed using SPSS statistical software. A frequency analysis was conducted to determine the participants' top choice of multitasking activity. The results indicated that nearly half of the participants use Facebook™ (46.3%) as their top choice. The second most frequently reported activity was texting (18%), followed by emailing (9.3%), and Internet

browsing for entertainment purposes (6.2%). Overall, these findings are largely consistent with previous research (Kraushaar & Novak, 2010).

Moreover, participants' ratings of their likelihood to engage in those multitasking activities tended to fall at the midpoint of the scale (M = 3.69, SD = 1.40), indicating that the students are *somewhat* likely to multitask during classroom lectures. Once again, these results may be subject to student underreporting of technology use (Kraushaar & Novak, 2010).

Lastly, a linear regression was conducted to determine whether either of the demographic variables predicted participants' likelihood to multitask. Both predictors (age and gender) were entered into the regression. The overall model was significant, $F_{(2,385)} = 4.41$, $p < .05$, $R^2 = .022$. However, only age significantly predicted participants' likelihood to multitask, $t_{(1, 385)} = -2.90$, $p < .01$. Specifically, younger participants were more likely to engage in multitasking activities. This finding is important, because it has implications for the learning outcomes. Specifically, as the increased affordability, availability, and usability of mobile devices makes them increasingly more likely to be utilized in an educational context (Liu, 2007; Motiwalla, 2007), concomitantly, there may also be an increase in distractive activities, which will detract from learning. These possibilities are particularly salient among cohorts that are growing up with mobile technologies available to them all of their lives, as younger cohorts also believe that multitasking is '*easy*,' and that they are good at it (Carrier, Cheever, Rosen, Benitez & Chang, 2009). These beliefs make it likely that they also believe their performance will not be negatively impacted by multitasking.

In conclusion, the findings from these studies indicate that students engage in high levels of distracting multitasking, with younger students engaging in more distracting behaviours than older students. In addition, even when technology is used for productive learning purposes, such as typing notes, students often engage in distracting multitasking activities as well. These results are concerning, as previous research has established that distracting multitasking has detrimental effects on learning performance (e.g. Fried, 2008; Hembrooke & Gay, 2003; Wood et al., 2012).

Implications from the current studies point to a contradiction that impacts educators as well as policy makers. Specifically, technology has consistently been shown to have a small, but positive effect on learning outcomes when used to support traditional instructional methods; however, the same technologies clearly can generate learning decrements when distracting and off task activities are permitted to occur. Ensuring instructionally appropriate use of technology when used in the classroom is clearly going to be a concern both for practical applications and for researchers trying to determine what or how much 'other' activity is beneficial when students use technologies independently during learning. Moreover, concerns have been raised in regards to the increased rates of academic misconduct due to technology use in the classroom (Baetz, Wood, Zivcakova, Nosko, De Pasquale & Archer, 2011; Mangan, 2001). For these reasons, faculty members at several universities have sought to reduce or limit students' use of technologies in the classroom (e.g. Fried, 2008; Weaver & Nilson, 2005), or accept policies that regulate the use of technology in the

classroom. One such policy that takes into consideration the needs of faculty and students, while respecting the issues of academic integrity, has recently been developed at Wilfrid Laurier University (Wilfrid Laurier University Senate, 2012). Such policies may serve as useful examples to instructors, faculty members, and administrators at educational institutions who seek to adopt or implement a technology use policy in a way that balances the need to ensure appropriate instructional use, while encouraging students to learn using technologies that can enhance engagement, persistence, and interest.

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