Journal of Information Technology Education: Innovations in Practice

An Official Publication of the Informing Science Institute InformingScience.org

JITEiip.org

Volume 20, 2021

NEW FINDINGS ON STUDENT MULTITASKING WITH MOBILE DEVICES AND STUDENT SUCCESS

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ABSTRACT

Aim/Purpose	This paper investigates the influence of university student multitasking on their learning success, defined as students' learning satisfaction and performance.
Background	Most research on student multitasking finds student multitasking problematic. However, this research is generally from 2010. Yet, today's students are known to be digital natives and they have a different, more positive, relationship with mobile technologies. Based on the old findings, most instructors ban mobile technology use during instruction, and design their online courses without regard for the mobile technology use that happens regardless of their ban. This study investigates whether today's instructors and learning management system interface designers should take into account multitasking with mobile technologies.
Methodology	A quasi-experimental design was used in this study. Data were collected from 117 students across two sections of an introductory Management Information Systems class taught by the first author. We took multiple approaches and steps to control for confounding factors and to increase the internal validity of the study. We used a control group as a comparison group, we used a pre-test, we controlled for selection bias, and we tested for demographic differences between groups.
Contribution	With this paper, we explicated the relationship between multitasking and learning success. We defined learning success as learning performance and learning satisfaction. Contrary to the literature, we found that multitasking involving IT texting does not decrease students' learning performance. An explanation of

Accepting Editor Donna Jean Satterlee | Received: January 8, 2021 | Revised: March 3, 2021 | Accepted: March 4, 2021.

Cite as: Eseryel, U. Y., Jiang, D., & Eseryel, D. (2021). New findings on student multitasking with mobile devices and student success. *Journal of Information Technology Education: Innovations in Practice, 20,* 21-35. https://doi.org/10.28945/4723

	this change is the change in the student population, and the digital nativeness between 2010s and 2020 and beyond.
Findings	Our study showed that multitasking involving IT texting does not decrease students' performance in class compared to not multitasking. Secondly, our study showed that, overall, multitasking reduced the students' learning satisfaction despite the literature suggesting otherwise. We found that attitude towards multitasking moderated the relationship between multitasking and learning satisfaction as follows. Individuals who had a positive attitude towards multitasking had high learning satisfaction with multitasking. However, individuals who had positive attitude toward multitasking did not necessarily have higher learning performance.
Recommendations for Practitioners	We would recommend both instructors and the designers of learning management systems to take mobile multitasking into consideration while designing courses and course interfaces, rather than banning multitasking, and assuming that the students do not do it. Furthermore, we recommend including multitasking into relevant courses such as Management Information Systems courses to make students aware of their own multitasking behavior and their results.
Recommendations for Researchers	We recommend that future studies investigate multitasking with different instruction methods, especially studies that make students aware of their multitasking behavior and its outcomes will be useful for next generations.
Impact on Society	This paper investigates the role of mobile multitasking on learning performance. Since mobile technologies are ubiquitous and their use in multitasking is common, their use in multitasking affects societal performance.
Future Research	Studies that replicate our research with larger and more diverse samples are needed. Future research could explore research-based experiential teaching methods, similar to this study.
Keywords	multitasking, undergraduate students, learning success, learning performance, learning satisfaction, quasi-experiment

INTRODUCTION

Multitasking is doing multiple tasks simultaneously. It is characterized by interleaving different tasks at the same time and switching among these tasks (Adler & Benbunan-Fich, 2013). The multitasker switches attention from one task to another while receiving information about how to respond to these tasks (Brake et al., 2017). Multitasking is a global trend, rather than a culture-specific behavior (Hwang et al., 2014). The major motives for multitasking are information, social, enjoyment, efficiency and habit (Hwang et al., 2014).

Today, multitasking is prevalent among the undergraduates, especially the Net generation (Carrier et al., 2009). Yet, learning platforms and interfaces do not take into account that the students will be multitasking in both classroom and online teaching. Gasser and Palfrey (2009) suggest that educators must understand the challenges of multitasking and talk to students about the uses and limitations of multitasking as part of school information and media literacy programs.

While the majority of multitasking studies focus on the negative impact on learning (e.g., Bowman et al., 2010; Ellis et al., 2010; Fox et al., 2009; Fried, 2008; Grinols & Rajesh, 2014; Hembrooke & Gay, 2003; Kraushaar & Novak, 2010), a relatively recent review of multitasking literature found

otherwise, thereby conflicting with the majority of the findings. Van der Schuur et al. (2015) searched three major databases (PsychINFO, ERIC, and CMMC) and identified 8448 citations. Among those, 56 studies met their inclusion criteria; nine studies on cognitive control, 43 on academic performance, and four on socioemotional functioning. The analysis of the articles showed a small to moderate negative relationship between media multitasking and the three domains of youth's functioning, namely cognitive control, academic performance, and socioemotional functioning. Importantly, they did not find any causal direction of this relationship (van der Schuur et al., 2015).

Multitasking with mobile phones while learning is prevalent, and understanding this issue has urgency (Chen & Yan, 2016). According to the latest Pew Research survey (2019), 96% of Americans own a cellphone, and 96% of people in age bracket of 18-29 own a smartphone. College students send an average of 97 text messages per day, 71 of which are sent while doing homework (Junco & Cotten, 2011). According to a pilot study, 53% of students reported text messaging during classes (Burns & Lohenry, 2010). Multitasking is also prevalent for online courses: 56.5% of students report multitasking when they are online (Moreno, Jelenchick, Koff, Eickhoff, et al., 2012).

While texting during course activities is this wide-spread, especially problematic is the fact that neither instructors nor the learning management systems designers take into the impacts of it. Rather, most instructors ineffectively forbid the use of technologies for any purpose other than taking class notes or using a software that is being taught at that moment. The students, on the other hand, continue to multitask in classes, regardless of instructions not to.

The question remains: should instructors and interface designers take into account multitasking while designing courses, choosing technologies, and designing interfaces? If the students are allowed to multitask on tasks that are not directly relevant to class, such as communicating with others via text, would student learning success be affected positively or negatively? In deciding what to do, there are two aspects of learning success to take into account: (1) students' learning performance; and (2) students' learning satisfaction. While student learning is seen as the ultimate goal, the learning satisfaction is what drives students' wish to further study the subject. Moreover, students' learning satisfaction usually determines how successful the professor is in teaching. This is typically measured by the students' surveys of instruction. Therefore, our main research question is: what is the relationship between multitasking and learning success, i.e., (a) learning performance, and (b) learning satisfaction among business students? Secondly, we investigate the relationship between attitude towards multitasking and learning success.

Human-Computer Interaction (HCI) scholars are well-positioned to research multitasking because the combination of user behavior knowledge with a keen understanding of technology platforms enables HCI scholars to recommend how to improve user performance and the design of interfaces (Adler & Benbunan-Fich, 2013).

In this study, we conducted a quasi-experiment study with 117 students to identify the relationship between multitasking with mobile technologies and learning success, as well as the relationship between student attitudes towards multitasking and students' learning success. Our study showed that multitasking involving IT texting does not decrease students' performance in class compared to not multitasking. Secondly, our study showed that, overall, multitasking reduced the students' learning satisfaction despite the literature suggesting otherwise. We found that attitude towards multitasking moderated the relationship between multitasking and learning satisfaction. Individuals who had a positive attitude towards multitasking had high learning satisfaction with multitasking; however, individuals who had positive attitude toward multitasking did not necessarily have higher learning performance. The key stakeholders for these findings are the students, instructors, and instruction technology designers. The findings suggest that while key stakeholders can incorporate mobile technologies as part of instructional methods and technologies without affecting student performance, they should not force students who have negative attitude toward mobile multitasking to use mobile technologies in class in order to ensure high levels of learning satisfaction. Our finding is different than

the previous literature, outlined in the literature review section, that suggests that multitasking affects student performance negatively.

In the following sections, we discuss the role of multitasking with mobile technologies in today's education, as well as summarizing the literature on texting. We end the literature review section with our hypotheses. This section is followed by the methodology, which introduces the participants, experiment design, and controls we put in place for confounding factors. Our paper concludes with findings, conclusions and discussion sections.

LITERATURE REVIEW

MULTITASKING WITH MOBILE TECHNOLOGIES IN TODAY'S EDUCATION

Despite the prevalence of multitasking with mobile technologies today, instructors often do not allow students to use their mobile phones and laptops for other than class purposes for fear that such multitasking would reduce students' learning performance and satisfaction. Learning performance is important because it allows the measurement of how well the students learn. Much of the literature focusing on the impact of learning performance were conducted around the 2010s or earlier. Since then the reach of information technology to younger ages has boomed. Many college goers may not even remember the mobile technologies before smart phones. Carrier et al.'s (2009) study comparing multitasking across generations shows that the younger generations report lower difficulty when multitasking and multitask more than the older generations. These older studies focusing on the effect of multitasking on students' learning suggested that students who multitask spent more time finishing their tasks and possibly made more mistakes (Bowman et al., 2010; Ellis et al., 2010; Fox et al., 2009; Fried, 2008; Grinols & Rajesh, 2014; Hembrooke & Gay, 2003; Kraushaar & Novak, 2010). Regardless of students' gender or GPA, the college goers of the 2010s who multitasked in class performed worse and got a lower grade than those who did not (Ellis et al., 2010).

The students who are college goers in 2021 and beyond are expected to be much more comfortable with information technologies because they were given smart phones from earlier ages. They are digital natives. Between 2009 and 2015, it was found that younger adults were more likely to multitask than older adults (Brasel & Gips, 2011; Carrier et al., 2009; Carrier et al., 2015) both in electronic and nonelectronic multitasking (Zwarun & Hall, 2014), making today's college students especially likely to multitask and to do so much more easily.

Moreover, extant literature shows that the college students often multitask with information technologies during classes regardless of whether the instructors allow them or not. Two-thirds of the students reported using electronic media while in class, either for doing homework or studying (Jacobsen & Forste, 2010, p. 279). Often times, students use their mobile phones for texting and accessing social networking sites (Ellis et al., 2010, p. 4). Students multitask in both online and face-to-face courses (Lepp et al., 2019). Similarly, when using the Internet, college students commonly engage in multiple online activities simultaneously (Moreno, Jelenchick, Koff, & Eickhoff, 2012). This means that if college students need to use the Internet for an online course, they tend to multitask (Lepp et al., 2019).

Thus far, we have discussed multitasking with respect to learning performance. A second important determiner of learning success is learning satisfaction. Learning satisfaction is important because that is how we measure and evaluate the success of the courses (Alqurashi, 2019). Not only do the 2020s college goers multitask more than the college goers of the 2010s, but multitasking may increase today's college goers' learning satisfaction as well. Young people tend to highly rate multitasking, which could be because the younger generations have grown up in the world that moves very fast and where technology is very prevalent (Willingham, 2010). Today's students are just as busy as today's employees in that they have to balance many competing demands. Courses are becoming increasingly packed with higher requirements, and many more assignments. In addition, students are expected to

have extracurricular activities and success such as volunteering, being active in student clubs or playing sports (Eccles & Barber, 1999). Working on similar tasks simultaneously is a way people alleviate some of the workload stress they have (Carrier et al., 2015). Therefore, many students multitask in order to get their assignments done quickly to make time for other activities. People also feel internal benefits and rewards from accomplishing multiple tasks. When media is involved individuals feel more efficient and have a greater sense of control over tasks (Robinson, 2017).

Multitasking has many benefits for the individual who is doing it. Multitasking helps satisfy information needs (Wang & Tchernev, 2012), thereby satisfying hedonic needs by creating a pleasant feeling (Kononova & Yuan, 2017), or satisfying the need to feel more efficient and have a greater sense of control over tasks (Robinson, 2017). Indeed, Bardhi et al. (2010) found that multitasking gives the impression of control, enjoyment, connection and efficiency to individuals who do it. In their study of multitasking college students, Lin (2019, p. 1674) found four motivations for multitasking: (a) greater control over their media consumption experiences; (b) processing related content more efficiently; (c) greater hedonic experiences through multiple media stimuli; and (d) connecting with friends and family.

Thus far, we reviewed the influence of multitasking on the learning success of the students. However, we have not included in this equation the impact of student attitudes toward multitasking. Individuals' attitudes toward technology impacted their technology use and related success (Porter & Donthu, 2006). However, in the literature on multitasking, students' attitudes towards multitasking has not been investigated. Based on the literature on the influence of attitude on success, we expect that student attitudes toward multitasking will increase their learning satisfaction while multitasking.

Even though we expect the students with a higher preference towards multitasking to be more satisfied with their learning when allowed to multitask, it is a fact that multitasking takes a toll in cognition (Srivastava, 2013). When more tasks are done simultaneously, this increases the cognitive load (Srivastava, 2013). Extant research on information processing suggests that highly familiar, meaningful stimuli are compatible with existing cognitive structures. Such stimuli will be processed more rapidly than less meaningful stimuli Craik and Lockhart (1972, p. 676). We expect that the skill with which digital natives almost automatically switch between IT-related tasks will help them handle the cognitive load of their second task of using information technologies in that they will not be overloaded enough to influence their performance negatively. However, we still expect that the learning performance of those who have positive attitude toward multitasking will not be higher than that of individuals with negative attitude toward multitasking. This is because, based on the argument of Craik and Lockhart (1972) for their learning performance to be higher than those with negative attitude towards multitasking, they should have had prior familiarity with the learning material. Yet, multitasking with technology does not guarantee that the students who have positive attitude towards multitasking has more access to knowledge of business or information technology topics as advanced as those that are taught in business or management information systems curriculum. In fact, many of the new terminologies taught in management information technologies may be new to college students. Therefore, regardless of their positive attitude towards multitasking, the multitasking students may not be necessarily expected to perform better than those who have negative attitudes toward multitasking.

Texting

A major way that mobile phone multitasking results in distraction is through distraction sources (Campbell, 2006). Chen and Yan (2016) identified three distraction sources; namely, the ring of the mobile phone, texting, and Facebook. In this study, we focus on texting as the mobile multitasking behavior, since the ring of a mobile phone is an unexpected event rather than a multitasking type, and Facebook is not as commonly used in 2020 by undergraduate students as before. Several researchers investigated texting and its influence on learning performance. These are described here.

Barks et al. (2011) simulated an online lecture situation with 37 undergraduate students by using a 10-minute videotaped lecture with randomly assigned students to texting versus only listening groups. They found that the learning performance, as measured by performance on follow up questionnaire on the lecture, was significantly lower in texting group.

Ellis et al. (2010) conducted an experiment with 62 undergraduate students with texting condition and no mobile phone conditions. The students in the texting condition sent three texts to the instructor. Similar to Barks et al.'s (2011) study, Ellis et al. (2010) found that the non-texting group outperformed texting group even when controlled for gender and GPA.

Gingerich and Lineweaver (2013) conducted experiments with 67 and 56 undergraduate students by randomly assigning students to texting and non-texting students and found that non-texting students both performed better on follow up quiz, and they felt more confident in predicting their performance on the quiz.

Harman and Sato (2011) conducted a survey to find the relationship between texting frequency, student attitude toward in-class texting, and their GPA. They identified that those students who reported exchanging more texts had lower GPA's.

Junco (2012) conducted a survey of 1,839 students and found that students reported frequently sending and receiving texts during the course activities. While they used other information and communication technologies, they did so to a lesser extent. The author investigated the relationship of multitasking with student GPA and found that only texting and Facebook use were negatively related to GPA.

To sum up the literature on texting, most of researchers conducted experiments and some conducted surveys to investigate the relationship between texting behavior and learning or general academic performance, and unanimously finding a negative relationship. We have not found studies that investigate the other element of learning success by testing the relationship between texting behavior and learning satisfaction. Lastly, none of these studies investigated the attitudes of the students towards multitasking, and whether it influenced learning success (namely, learning performance, and satisfaction). Therefore, to fill in this gap, we investigate the following research questions using a quasi-experimental approach. We found the experimental design to be one of the most frequently used techniques in this topic. We decided to opt for a similar approach by choosing quasi-experiments, which is a better method when randomizing the subjects are unethical, having separate location are not possible, and when the sample size is small as in the case of this study (Harris et al., 2006).

HYPOTHESES

Our general research questions were: What is the relationship between multitasking and learning success; i.e., (a) learning performance and (b) learning satisfaction among business students? Secondly, what is the relationship between attitude towards multitasking and learning success? Under the guidance of these research questions, the following hypotheses were developed to be tested:

H1: Multitasking involving IT texting does not decrease students' performance in class compared to not multitasking

H2: Students who multitask during classes have more learning satisfaction than those who do not multitask during classes

H3: Students who have more favorable attitudes towards multitasking will not have higher performance when multitasking.

H4: Students who have more favorable attitudes towards multitasking have higher learning satisfaction when multitasking.

METHODOLOGY

PARTICIPANTS

An experimental design was used in this study to test the hypotheses. The data for this study constitute the business degree students' learning performance data from Management Information System courses where the students multitasked during the lecture and then answered questions about the lecture as well as a control group who listened to the lecture without multitasking.

Data were collected from 117 students across multiple sections of an introductory Management Information Systems class taught by the first author. Table 1 provides an overview of the demographics of the participants: 69.23% of the participants are male, 29.91% are female, and one participant chose Other option. It is expected that there are more male than female since this course is about information technologies. A majority of the participants are between the age of 20 and 30 (80.34%), 17.95% of the students are under 20, and 56.41% of the participants were juniors, which represents the largest class standing.

Table 1. Demographics of the sample

	Value	Frequency	Percentage
Gender	1: Male	81	69.23%
	2: Female	35	29.91%
	3: Other	1	0.85%
Age	1: Under 20	21	17.95%
	2: 20-30	94	80.34%
	3: 31 or over	2	1.71%
Class Standing	1: Freshman*	2	1.71%
	2: Sophomore*	39	33.33%
	3: Junior*	66	56.41%
	4: Senior*	10	8.55%

***Note:** Freshman, sophomore, junior and senior are the names of college years 1, 2, 3, and 4 respectively within the United States

QUASI-EXPERIMENT DESIGN

The first author conducted a controlled quasi-experiment with the students based on a discussion in class. In order not to bias students for or against multitasking, the instructor explained to the students that multitasking may have advantages and disadvantages. There were further in-class discussions on how students tend to multitask in this and in other classes. The instructor created an open, non-judgmental atmosphere that allowed the students to easily talk about how they multitask, even when they multitask against the wishes of the instructors.

Prior to the study, the students were told that participation was not mandatory, and that instead of being in an experimental or a control group, they could choose to do a graded assignment. Further, the students were communicated that they had the right to opt out at any time and receive another assignment for the same grade. None of the students opted out of the study in favor of another assignment, meaning all students were either in the experiment group or the control group.

This research employed a quasi-experimental design approach. Instead of randomly assigning students into treatment group and control group, the students were allowed to choose whether they would be in the experimental group or the control group. Those who chose to be in the control

group could still measure their learning. In the end, there were 70 participants in the treatment group and 47 participants in the control group. In our field, both experiments, where participants are randomly assigned to treatments, and quasi-experiments which are not randomized, are common. Quasi-experiments are typically preferred when randomizing the subjects are unethical, having separate location are not possible, and when the sample size is small as in the case of this study (Harris et al., 2006). In this study, we knew that some students had negative attitudes towards multitasking and had strong preference towards single tasking to learn the matter, and therefore we found it unethical to force them to multitask by randomizing the treatment. Instead of randomizing the study, we chose to control for confounding factors as reported in the next section, titled "Controlling for Confounding Factors".

To select a task that is common in the business world (namely, communicating while doing work/while attending work-related training), the participants in the treatment group were asked to text back and forth with a friend, while at the same time listening to the lecture. In contrast, the participants in the control group were not allowed to text but were still asked to listen to the lecture. The students in both groups were prompted repeatedly that they should be paying attention to the lecture and that 5-6 questions (out of 40) were going to be asked in the mid-term exam from the chapter at hand. This prompting ensured that the students paid attention to the lecture as best as they could. After the lecture, the students were given a 5-question quiz based on the key content of the lecture and, immediately after the quiz, they were given the answers and were asked to calculate how many questions they answered correctly. Lastly, they were given a general survey that included their demographic information, their grades, interest level, and their learning satisfaction and their general multitasking habits. The items for learning satisfaction were self-developed (see the items in the Appendix).

To be fair to all students, and to ensure that the experiments do not affect student grades, after the experiment was concluded, the topic taught during the experiment was actually NOT included in the exam. Furthermore, other means to learn the same information (such as a video and the slides of the presentation) were provided for those who might have missed the content due to multitasking experiments.

Controlling for Confounding Factors

Since random assignment was not employed in the experiment, we took multiple approaches and steps to control for confounding factors and to increase internal validity of the study.

First, we used a control group as a comparison group, which is believed to be more valid than quasi-experiment without control groups, in that using control groups can help adjust for confounding variables statistically (Harris et al., 2006).

Second, we used a pre-test to assess the initial resemblance between the two groups in terms of their knowledge of the content covered in the class. The combination of control groups and pretest-post-test design is belied to be more credible than using only one of them (Cook et al., 1979). We chose to use a set of questions that were different from the one in the post-test but one that still covered the same content. We believe that using the same questions in the pre-test and post-test might make the test too easy which makes it difficult to detect the effect of the treatment. The pre-test was given to the students before the lecture. After the experiment, we used ANOVA to analyze the mean difference between the two groups in the pre-test, and the difference was not significant ($F=.462$, $p>0.05$), which indicated that the two groups' knowledge of the content covered in the lecture was not significantly different.

Third, we also controlled for selection bias. Selection bias happens when "selection results in differences in unit characteristics between conditions that may be related to outcome differences" (Harris et al., 2006, p. 20). In our experiment, the participants in the control group were given the option not to multitask. They could have chosen not to multitask due to their unfavorable attitudes toward

multitasking, which might have affected the outcome differences. Thus, they are subject to selection bias. Thus, we self-developed items for attitudes towards multitasking (see the items in Appendix) and tested the difference in the two groups in terms of attitudes towards multitasking. The result shows that there was not significant difference between the two groups ($F=3.341$, $p>0.05$) in terms of attitudes toward multi-tasking.

Lastly, we also tested for the demographical differences between the two groups and found that there were no significant differences between the two groups in terms of age and gender.

Table 2. Group difference in age and gender

	F value	P value
Gender	1.241	.268
Age	.910	.342

FINDINGS

We used independent t-test in SPSS to analyze the data. Table 3 presents the descriptive statistics for score, learning satisfaction and attitude.

Table 3. Descriptive statistics

	N	Range	Mean	Std. Dev	Variance	Skewness	Kurtosis
Score	117	5	2.89	1.285	1.651	-.236	-.411
Learning Satisfaction	117	6.00	4.0301	1.38118	1.908	.032	-.359
Attitude	117	5.00	3.1462	1.22567	1.502	.262	-.297

For H1, we found that there was no significant difference in learning performance between the treatment group (group 1) and the control group (group 2) ($t=1.744$, $p>0.05$). Thus, H1 was supported. For H2, we found that the learning satisfaction for the treatment group was significantly lower than the control group ($t=-6.096$, $p<0.01$). Thus, H2 was not supported. Next, for H3 and H4, we only investigated the treatment group in order to examine the effects of attitudes on learning satisfaction and learning performance when multitasking. We used regression in SPSS to test the two hypotheses. We also added the demographic information including age, gender, and class standing as control variables. For H3, we found that the effect of attitudes on learning performance is not significant ($B=0.086$, $p>0.05$). Therefore, H3 was supported. For H4, we found that attitudes towards multitasking have positive effect on learning satisfaction ($B=0.276$, $p<0.05$). Table 4 below summarizes the final results.

Table 4. Hypotheses testing results

	t value/path estimates	p value	Hypothesis supported?
H1	1.744	0.057	Yes
H2	-6.096	0.000	No
H3	0.086	0.576	Yes
H4	0.276	0.043	Yes

CONCLUSION

Our study indicated that multitasking with mobile technologies by texting does not decrease students' performance in class compared to not multitasking. Moreover, we found that, overall, multitasking reduced the students' learning satisfaction despite the extant research suggesting otherwise. Our findings suggest that attitude towards multitasking moderated the relationship between multitasking and learning satisfaction. Individuals who had a positive attitude toward s multitasking had high learning satisfaction with multitasking. However, individuals who had positive attitude toward multitasking did not necessarily have higher learning performance.

The practical contributions of these findings are our recommendations to the instructors, especially courses on management information systems. We would recommend that instructors stop prohibiting technology use in classrooms; instead, assume that such multitasking is happening, and choose information technology platforms that take this behavior into account. System designers of learning management systems could also take the use of multitasking with texting into account while designing these systems. We further suggest the coverage of this or other articles in classes to discuss the impact of multitasking, so that the students can become aware of their multitasking behaviors and their outcomes, and thus make informed choices on when and how to multitask.

The influence of multitasking on learning satisfaction changes among those who have positive attitude toward multitasking versus those who do not. Therefore, we recommend that instructors stay away from using exercises and alternative teaching approaches that are standard across the board. Instead of forcing all students to do multitasking, allow those who prefer to multitask to do so, and let others just listen to the course material without multitasking. With this, we also recommend multitasking researchers to prefer quasi-experiments to experiments, where multitasking behavior is randomly chosen, and thus potentially forced on those students who have negative attitudes towards multitasking.

We would specifically recommend that multitasking with information technologies be covered as part of the management information systems course contents within the business programs to make the students aware of the need for multitasking in the work environment, and to make them aware of their own multitasking behaviors. This awareness is the first step in helping them reflect on their own behavior, and to prepare for effective multitasking.

DISCUSSION

In this study, we explicated the relationship between multitasking and learning success. We defined learning success as learning performance and learning satisfaction. The first part of our research question was "What is the relationship between multitasking and learning success, i.e., (a) learning performance?" We had hypothesized that multitasking involving IT texting does not decrease students' performance in class compared to multitasking, which was supported. This is contrary to the literature that was commonplace in the 2010s that suggested that multitasking resulted in lower performance (Bowman et al., 2010; Ellis et al., 2010; Fox et al., 2009; Fried, 2008; Grinols & Rajesh, 2014; Hembrooke & Gay, 2003; Kraushaar & Novak, 2010). An explanation of this change is the change in the student population and digital nativeness between the 2010s and 2020. Those students who are college goers in the 2020s have started using information technologies from a younger age. Therefore, they have had more exposure to information technologies compared to the college goers of 10 years ago.

A second component of learning success is learning satisfaction. Therefore, the second part of our research question was "What is the relationship between multitasking and learning success, i.e., (b) learning satisfaction among business students?" Our study showed that, overall, multitasking reduced the students' learning satisfaction despite the literature suggesting otherwise. We found that attitude towards multitasking moderated the relationship between multitasking and learning satisfaction as

follows. Individuals who had a positive attitude towards multitasking had high learning satisfaction with multitasking. However, as we expected, individuals who had positive attitude toward multitasking did not necessarily have higher learning performance. This can be explained by the fact that there is no correlation between attitude towards multitasking and familiarity with business and management information systems concept familiarity. Therefore, when students who have positive attitudes towards multitasking are allowed to multitask, they do better in only one aspect of learning success; namely, they improve on learning satisfaction.

The limitation of our study is the small sample size and the fact that we conducted the study in a relatively homogenous group of American students. This study could be replicated with larger sample sizes and across different cultures to find whether different findings are obtained based on the country of origin.

Future studies should investigate the type of instruction methods that can help students be more aware of their multitasking behavior and to change their multitasking behavior according to their learning needs.

REFERENCES

Adler, R. F., & Benbunan-Fich, R. (2013). Self-interruptions in discretionary multitasking. *Computers in Human Behavior, 29*(4), 1441-1449. https://doi.org/10.1016/j.chb.2013.01.040

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Education, 40*(1), 133-148. https://doi.org/10.1080/01587919.2018.1553562

Bardhi, F., Rohm, A. J., & Sultan, F. (2010). Tuning in and tuning out: Media multitasking among young consumers. *Journal of Consumer Behaviour*, *9*, 316-332. https://doi.org/10.1002/cb.320

Barks, A., Searight, H., & Ratwik, S. (2011). Effects of text messaging on academic performance. *Journal of Pedagogy and Psychology, 4*(1), 10-15. https://doi.org/10.2478/v10195-011-0039-0

Bowman, L. L., Levine, L. E., Waite, B. M., & Gendron, M. (2010). Can students really multitask? An experimental study of instant messaging while reading. *Computers & Education, 54*(4), 927-931. https://doi.org/10.1016/j.compedu.2009.09.024

Brake, W. G., Gervais, N. J., & Lacreuse, A. (2017). Ovarian hormones and prefrontal cortex-related cognition. *Hormones, Brain, and Behavior, 1*(3), 439-448. https://doi.org/10.1016/B978-0-12-803592-4.00016-X

Brasel, S. A., & Gips, J. (2011). Media multitasking behavior: Concurrent television and computer usage. *Cyberpsychology, Behavior, and Social Networking, 14*(9), 527-534. https://doi.org/10.1089/cyber.2010.0350

Burns, S. M., & Lohenry, K. (2010). Cellular phone use in class: Implications for teaching and learning: A pilot study. *College Student Journal, 44*(3), 805-810.

Campbell, S. W. (2006). Perceptions of mobile phones in college classrooms: Ringing, cheating, and classroom policies. *Communication Education, 55*(3), 280-294. https://doi.org/10.1080/03634520600748573

Carrier, L. M., Cheever, N. A., Rosen, L. D., Benitez, S., & Chang, J. (2009). Multitasking across generations: Multitasking choices and difficulty ratings in three generations of Americans. *Computers In Human Behavior, 25*(2), 483-489. https://doi.org/10.1016/j.chb.2008.10.012

Carrier, L. M., Rosen, L. D., Cheever, N. A., & Lim, A. F. (2015). Causes, effects, and practicalities of everyday multitasking. *Developmental Review: Perspectives in Behavior and Cognition, 35*, 64-78. https://doi.org/10.1016/j.dr.2014.12.005

Chen, Q., & Yan, Z. (2016). Does multitasking with mobile phones affect learning? A review. *Computers in Human Behavior, 54*, 34-42. https://doi.org/10.1016/j.chb.2015.07.047

Cook, T. D., Campbell, D. T., & Day, A. (1979). *Quasi-experimentation: Design and analysis issues for field settings* (Vol. 351). Houghton Mifflin.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671-684. https://doi.org/https://doi.org/10.1016/S0022-5371(72)80001-X

Eccles, J. S., & Barber, B. L. (1999). Student council, volunteering, basketball, or marching band: What kind of exracurricular involvement matters? *Journal of Adolescent Research*, *14*(1), 10-43. https://doi.org/10.1177/0743558499141003

Ellis, Y., Daniels, B., & Jauregui, A. (2010). The effect of multitasking on the grade performance of business students. *Research in Higher Education Journal, 8*(1), 1-10.

Fox, A. B., Rosen, J., & Crawford, M. (2009). Distractions, distractions: Does instant messaging affect college students' performance on a concurrent reading comprehension task? *CyberPsychology & Behavior, 12*(1), 51-53. https://doi.org/10.1089/cpb.2008.0107

Fried, C. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50*(3), 906-914. https://doi.org/10.1016/j.compedu.2006.09.006

Gasser, U., & Palfrey, J. (2009). Mastering multitasking. *Educational Leadership, 66*(6), 14-19.

Gingerich, A. C., & Lineweaver, T. T. (2013). OMG! Texting in class = UFail :(Empirical evidence that text messaging during class disrupts comprehension. *Teaching of Psychology, 41*(1), 44-51. https://doi.org/10.1177/0098628313514177

Grinols, A. B., & Rajesh, R. (2014). Multitasking with smartphones in the college classroom. *Business and Professional Communications Quarterly, 77*(1), 89-95. https://doi.org/10.1177/2329490613515300

Harman, B., & Sato, T. (2011). Cell phone use and grade point average among undergraduate university students. *College Student Journal*, 544-550.

Harris, A. D., McGregor, J. C., Perencevich, E. N., Furuno, J. P., Zhu, J., Peterson, D. E., & Finkelstein, J. (2006). The use and interpretation of quasi-experimental studies in medical informatics. *Journal of the American Medical Informatics Association, 13*(1), 16-23. https://doi.org/10.1197/jamia.M1749

Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education, 15*(1), 46-64. https://doi.org/10.1007/BF02940852

Hwang, Y., Kim, H., & Jeong, S.-H. (2014). Why do media users multitask? Motives for general, medium-specific, and content-specific types of multitasking. *Computers in Human Behavior, 36*, 542-548. https://doi.org/10.1016/j.chb.2014.04.040

Jacobsen, W. C., & Forste, R. (2010). The wired generation: Academic and social outcomes of electronic media use among university students. *Cyberpsychology, Behavior, and Social Networking, 14*(5), 275-280. https://doi.org/10.1089/cyber.2010.0135

Junco, R. (2012). In-class multitasking and academic performance. *Computers in Human Behavior, 28*(6), 2236-2243. https://doi.org/10.1016/j.chb.2012.06.031

Junco, R., & Cotten, S. R. (2011). Perceived academic effects of instant messaging use. *Computers and Education, 56*(2), 370-378. https://doi.org/10.1016/j.compedu.2010.08.020

Kononova, A. G., & Yuan, S. (2017). Take a break: Examining college students' media multitasking activities and motivations during study- or work-related tasks. *Journalism and Mass Communication Educator*, *72*(2), 183-197. https://doi.org/10.1177/1077695816649474

Kraushaar, J. M., & Novak, D. C. (2010). Examining the affects of student multitasking with laptops during the lecture. *Journal of Information Systems Education, 21*(2), 241-251.

Lepp, A., Barkley, J. E., Karpinski, A. C., & Singh, S. (2019). College students' multitasking behavior in online versus face-to-face courses. *SAGE Open*, 1-9. https://doi.org/10.1177/2158244018824505

Lin, T. T. C. (2019). Why do people watch multiscreen videos and use dual screening? Investigating users' polychronicity, media multitasking motivation, and media repertoire. *International Journal of Human-Computer Interaction*, *35*(18), 1672-1680. https://doi.org/10.1080/10447318.2018.1561813

Moreno, M. A., Jelenchick, L., Koff, R., Eikoff, J., Diermyer, C., & Christakis, D. A. (2012). Internet use and multitasking among older adolescents: An experience sampling approach. *Computers in Human Behavior, 28*(4), 1097-1102. https://doi.org/10.1016/j.chb.2012.01.016

Moreno, M. A., Jelenchick, L., Koff, R., & Eickhoff, J. (2012). Depression and internet use among older adolescents: An experience sampling approach. *Psychology, 3*(9A), 743-748. https://doi.org/10.4236/psych.2012.329112

Porter, C. E., & Donthu, N. (2006). Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics. *Journal of Business Research*, *59*(9), 999-1007. https://doi.org/https://doi.org/10.1016/j.jbusres.2006.06.003

Pew Research Center. (2019). *Mobile fact sheet*. https://www.pewresearch.org/internet/fact-sheet/mobile/#who-owns-cellphones-and-smartphones

Robinson, H. R. (2017). Towards an enahnced understanding of the behavioural phenomenon of multiple media use. *Journal of Marketing Management, 33*(9-10), 706-707. https://doi.org/10.1080/0267257X.2017.1328457

Srivastava, J. (2013). Media multitasking performance: Role of message relevance and formatting cues in online environments. *Computers In Human Behavior*, *29*(3), 888-895. https://doi.org/https://doi.org/10.1016/j.chb.2012.12.023

van der Schuur, W. A., Baumgartner, S. E., Sumter, S. R., & Valkenburg, P. M. (2015). The consequences of media multitasking for youth: A review. *Computers in Human Behavior, 53*, 204-215. https://doi.org/10.1016/j.chb.2015.06.035

Wang, Z., & Tchernev, J. M. (2012). The "myth" of media multitasking: Reciprocal dynamics of media multitasking, personal needs, and gratifications. *Journal of Communication*, *62*, 493-513. https://doi.org/10.1111/j.1460-2466.2012.01641.x

Willingham, D. T. (2010). Ask the cognitive scientist: Have technology and multitasking rewired how students learn? *American Educator*, *42*(2), 28-32.

Zwarun, L., & Hall, A. (2014). What's going on? Age, distraction, and multitasking during online survey taking. *Computers in Human Behavior, 41*, 236-244. https://doi.org/10.1016/j.chb.2014.09.041

APPENDIX

Items used to measure learning satisfaction:

(1) I was satisfied with how I did the in-class assignment.
(2) I was fully satisfied with the way I learned in class.
(3) I feel that I learned the lecture material very well.
(4) The assignment helped me follow the lecture better.
(5) Because of the assignment, I could concentrate much better on the lecture.
(6) Assignment helped me learn the lecture material better.
(7) I think I've done the assignment very well.
(8) I think I listened to the lecture very well.

Items used to measure attitudes towards multitasking:

(1) I prefer to work on several projects in a day, rather than completing one project and then switching to another.
(2) When doing a number of assignments, I like to switch back and forth between them rather than do one at a time.
(3) I like to finish one task completely before focusing on anything else. (Reverse coded.)
(4) It makes me uncomfortable when I am not able to finish one task completely before focusing on another task. (Reverse coded.)
(5) I am much more engaged in what I am doing if I am able to switch between several different tasks.
(6) I do not like having to shift my attention between multiple tasks. (Reverse coded.)
(7) I would rather switch back and forth between several projects than concentrate my efforts on just one.
(8) I don't like when I have to stop in the middle of a task to work on something else. (Reverse coded.)
(9) When I have a task to complete, I like to break it up by switching to other tasks intermittently.

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