The effect of multitasking on the grade performance of business students

Yvonne Ellis
Columbus State University

Bobbie Daniels
Jackson State University

Andres Jauregui
Columbus State University

Abstract

The growth and expansion of communication technology have created a multitasking generation of students who believe they are utilizing time more effectively by performing two or more tasks simultaneously. Multitasking refers to the concurrent processing of two or more tasks through a process of context switching. However, research by neuroscientists show that multitasking reduces the brain's ability to effectively retrieve information. The purpose of this study is to empirically examine whether multitasking in class affects the grade performance of business students. We conducted an experiment using 62 undergraduate business students enrolled in the first accounting principles course at a university in the Southeastern part of the United States. The students participated in a class lecture and afterwards were given a quiz covering the lecture content. One-half of the participants were allowed to multitask in the form of texting during a class lecture, while the other half of the participants were not. Our findings indicate that the exam scores of students who text in class are significantly lower than the exam scores of students who do not text in class. Thus, multitasking during class is considered a distraction that is likely to result in lower grade performance. The implications of this study can be very useful to students, instructors, administrators, and other academic stakeholders, about the effect of multitasking in a learning environment on students' grade performance.

Keywords: accounting, brain's memory systems, multitasking; technology; texting

Introduction

The growth and expansion of communication technology have created a multitasking generation of students who believe they are utilizing time more effectively by performing two or more tasks simultaneously. Multitasking refers to the concurrent processing of two or more tasks through a process of context switching. In a study by Foerde, Knowlton, and Poldrack (2006), the results show that the brain cannot process two relatively different thoughts at the same time. The brain switches between two different thoughts (context) giving the illusion that one is simultaneously processing both thoughts at the same time. Whenever the brain switches from one task to another, it saves the current state of the former task so it can come back to it later. Therefore, context switching between tasks costs more time because information is being processed at a much slower rate. However, dual task conditions do not reduce accuracy but reduce the amount of declarative learning[1] about a task, which reduces the brain's ability to retrieve information. Langer (2003) notes that the way information initially is processed may determine the way in which it is used. When information is processed mindlessly, it becomes frozen the way in which it was originally received. For example, students who study while listening to music or using the cell phone may find it difficult to retrieve that information during exam time.

Several studies show that students are great multitaskers and use technology on a daily basis for educational, job and personal use (Alsop, 2007; Heather, 2003; Walus, 2008; McAllister, 2009). However, there is a concern that the use of some technology in class hinders learning. Tanner, Stewart, Maples, Totaro and Gaines (2008) assert that undergraduate business students do not realize they may be sacrificing some aspects of their academics and study time due mostly to contemporary "technological distractions" such as YouTube, Facebook, and other similar electronic information technologies. Furthermore, Ophir, Nass and Wagner (2009) find that media multitasking is considered a challenge for human cognition. 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.

The purpose of this study is to provide empirical evidence on whether multitasking in a learning environment affects the grade performance of students. We conducted an experiment using 62 undergraduate business students enrolled in the first accounting principles course at an AACSB International accredited university in the Southeastern part of the United States. The students participated in a class lecture and afterwards were given a quiz covering the lecture content. The students were randomly assigned into a control or treatment group as they entered the lecture hall. One-half of the participants (treatment group) received written instructions to send text messages via cell phone, a form of multitasking, while the other half of the students (control group) did not text. A *t-test* was used to determine whether there exists a significant difference between the quiz scores of texting versus nontexting students. The results indicate that a significant difference exists in the quiz scores between texting versus nontexting students. The scores of texting students are significantly lower than the cores of nontexting students. Overall, evidence is provided that multitasking in a learning environment may result in lower

[1] According to neuroscientists, the brain has two memory systems. Declarative memory is one memory system associated with elaborative encoding and effortful retrieval process that depends on the prefrontal cortex of the brain (hippocampus). The other memory system involves a habitual learning process associated with automaticity, which does not require effortful attention or working memory, and it depends on the striatum part of the brain.

grade performance. The implications of this study are very useful to students, instructors, administrators, and other academic stakeholders about the effect of multitasking in a learning environment on the grade performance of students.

The remainder of the paper is as follows. The next section provides a discussion on multitasking literature, which is followed by the methodology. Next, we discuss and analyze the results of the study. We then conclude with a brief discussion of the limitations of the study and opportunities for future research.

Background

The Brain's Memory Systems

Many neuroscientists are using functional magnetic resonance imaging (fMRI)[2] to observe the function of the brain as it undergoes different learning processes involving dual task (multitasking) conditions. Foerde, Knowlton and Poldrack (2006) conducted an experimental study using 14 participants to examine the two competing memory systems of the brain under single and dual task conditions. The researchers examined the two competing memory systems of the brain function under a single task versus a dual task. The results of the study provide evidence that although a distraction does not decrease the overall learning level, it could result in the acquisition of knowledge that can be applied less flexibly in new situations. Thus, when dual task conditions are present, there is modulation in the two competing memory systems of the brain. The dual task condition is considered a distraction that reduces the ability to retain knowledge effectively.

In addition to the above study, Adcock, Constable, Gore and Goldman-Rakic (1999) examined the brain wave activity of 16 students under single and dual tasks conditions using functional MRI. They found that the brain's wave activity indicates that dual task conditions are more demanding than a single task condition. They asserted that the various specialized information processing systems in the brain may, by their interplay, accomplish the regulation of complex operations such as multitasking. In addition, Goel, Makale and Grafman's (2004) study also shows that the brain engages two memory systems depending on whether the information is familiar or unfamiliar. Reasoning involving meaningful familiar material engages the left hemisphere temporal lobe system and reasoning involving unfamiliar material engages the bilateral parietal system.

Media Technology in a Learning Environment

Media technological tools, if used appropriately, are powerful devices that can enhance learning. On the other hand, if they are used inappropriately, they can result in harmful consequences to learning. Many schools are embracing the use of technology in the classroom, while others view technology as a distraction that could hinder learning. Fried (2008) examined the use of laptops in the classroom to see how much time students spend multitasking. Results show that students spend a considerable amount of time multitasking and that the laptop is a great distraction to users and fellow students.

[2] Functional Magnetic Resonance Imaging (fMRI) is a specialized type of MRI that measures the hemodynamic response (blood flow) related to neural activity in the brain or spinal cord of humans or other animals.

Tanner, Stewart, Maples, Totaro and Gaines (2008) investigated students' perceptions about how they spend their time. The results show that students are not really sure how much time is spent on certain activities. A significant difference was found on the actual time versus pre-conceived time that students spend studying, watching television, surfing the Internet, attending class and studying. In addition, the study shows that students are multitasking in a learning situation. Multitasking by students mostly involve the use of cell phones for texting and accessing social networking sites (FaceBook, YouTube, etc).

In an interview between Ron Alsop, a Track Columnist with the *Wall Street Journal*, and Daphne Atkinson, Vice President for Industry Relations at the Graduate Management Admission Council, multitasking in class was a topic of discussion. Ms. Atkinson suggested that millennials' multitasking is driving some instructors wild in the classrooms. According to the Committee on Developments in the Science of Learning and the Committee on Learning Research and Educational Practice (2000), the challenge of education is to design technologies for learning that draw both from knowledge about human cognition and from practical applications of how technology can facilitate complex tasks in the workforce. Gendreau (2007) offered ways to manage technology in the workplace and home. Our study focuses on multitasking, in the form of texting in class and its effect on learning. Based on the above research we test the following hypotheses:

H1: There is no significant difference between the mean quiz scores of texting versus nontexting students.

H2a: There is no significant difference between the mean quiz scores of female versus male students without regard to texting.

H2b: There is no significant difference between mean quiz scores of texting versus nontexting females.

H2c: There is no significant difference between the mean quiz scores of texting versus nontexting males.

H3: There is no significant difference between the mean quiz scores of texting versus nontexting students based on GPA.

Methodology

Participants

Sixty-two undergraduate business students from a public AACSB International accredited business school located in the Southeastern part of the United States participated in the study. All the students were enrolled in the first accounting principles course, which is a required course for all business majors. Table 1 provides an overview of the demographics characteristics of the participants. Twenty-six (41.94%) of the participants are male and 36 (58.06%) are female. Thirty-three (53.23%) of the participants were sophomores, which represents the largest class standing. However, this is expected since the majority of business students do not take the first accounting course until their sophomore year. Pre-business majors represent 50 percent of the students in the study since students are not allowed to choose a major until they have successfully passed all required business courses. GPA was divided into two groups. Thirty-six (58.06%) students have a GPA ranging from 4.0 to 3.0, and 26 (41.94%)

students have a GPA below 3.0. University Institutional Review Board permission was obtained to conduct experiments using students.

Experimental Design

The study employed an independent t-test to examine the mean difference in test scores between texting and nontexing students at the .05 alpha level. The research of interest is to determine whether texting in class, a form of multitasking, affects the grade performance of students. To eliminate repeat students from tainting the results, the lecture included a chapter that would not be covered until the second accounting principles course. After the lecture, they were given a quiz consisting of 20 multiple choice questions from a computerized test bank that accompanies the textbook. The quiz scores may be lower than normal since the students were not told that they would be given a quiz after the lecture.

In order to achieve randomization, the instruction sheets were sorted in an order so that every other instruction sheet contained the treatment (texting). We randomly distributed the instruction sheets to each subject. Half of the students (31) received an instruction sheet requiring them to send the professor three different text messages (treatment) during the lecture. They could send the three text messages at any time during the lecture; however, all three text messages had to be sent before the end of the lecture. Texting the professor would provide evidence that the students in the treatment group did multitasking during the lecture. The other half of the students (31) was instructed to turn their cell phones off during the lecture. In addition, all students were instructed to not talk to anyone during the lecture in order to maintain anonymity among them about the treatment.

Results

Panel A of Table 2: Texting versus Nontexting

Panel A of Table 2 shows the results of texting versus nontexting students. Hypothesis 1 states that there is no significant difference between the mean quiz scores of texting versus nontexting students. The hypothesis is rejected. The results show that the quiz scores of texting students versus nontexting students are statistically different from zero ($t = 4.25$, $p = 0.0002$), which shows texting students scored lower than nontexting students. The results provide evidence that multitasking (texting) in a learning environment may result in lower grade performance.

Panel B of Table 2: Female versus Male

Further, to get a more robust finding, we extended our analysis to gender and GPA. Panel B of Table 2 examine whether there is statistical difference in quiz scores of males versus females without considering whether they text or not. Hypothesis 2a states that there is no significant difference between the quiz scores of males versus females. Hypothesis 2a is accepted. The results show that quiz scores of males versus females are not statistically different than zero ($t = -1.36$, $p = 0.1793$), which shows that males do not score higher than females. The results indicate that gender does not impact the learning ability of a person.

Panel C of Table 2: Texting versus Nontexting Females

We then performed an additional analysis to see whether texting impacts the grade performance of males and females. Hypothesis 2b states that there is no significant difference between the mean quiz scores of texting versus nontexting females. Hypothesis 2b is rejected. The results show that the quiz scores of texting versus nontexting females are statistically different from zero ($t = 3.99$, $p = 0.0003$), which shows that multitasking (texting) females score lower than nontexting females.

Panel D of Table 2: Texting versus Nontexting Males

Hypothesis 2c states that there is no significant difference between the mean quiz scores of texting versus nontexting males. Hypothesis 2c is rejected. The results show that the quiz scores of texting versus nontexting males are statistically different from zero ($t = 4.99$, $p = 0.0001$), which shows that texting males score lower than nontexting males. The results of the former two hypotheses provide evidence that regardless of gender, multitasking (texting) in a learning environment may result in lower grade performance.

Panel E: Texting versus Nontexting Based on GPA

Our final data analysis examines whether texting in class affects grade performance across different levels of GPA. Hypothesis 2d states that there is no significant difference in the quiz scores between texting versus nontexting students based on GPA level. Panel E of Table 2 show that hypothesis 2d is rejected. The results show that the quiz scores of texting versus nontexting students with a GPA of 3.0 or higher are statistically different from zero ($t = 3.47$, $p = 0.002$), which indicates that students with a GPA range from 4.0 to 3.0, who text score lower than students who do not text with the same GPA. Also, the results show that the quiz scores of texting versus nontexting students with a GPA lower than 3.0 are statistically different from zero ($t = 5.03$, $p = 0.0001$), which indicates that students with a GPA in the range from 3.0 or lower who text score lower than students who do not text with the same GPA. Overall, the results indicate that regardless of the student's GPA, multitasking (texting) results in lower grade performance.

The overall results of the study provide evidence that multitasking in a learning environment can result in lower grade performance of students regardless of gender or GPA. In addition, our results are similar to results found by neuroscientists who provide evidence that the brain is not able to retrieve information effectively under dual task conditions (multitasking). Texting during class is a form of multitasking, which is considered a dual task condition. Thus, findings from this study provide valuable information to students, educators, and other stakeholders about the effect of multitasking in a learning situation. Evidence shows that there is a cost associated with multitasking in a learning environment – lower grade performance.

Conclusion

The purpose of this study was to empirically examine whether multitasking in a learning environment has an effect on the grade performance of business students. We conducted an experiment using 62 undergraduate business students enrolled in the first accounting principles

course at an AACSB International accredited university located in the Southeastern part of the United States. The students are divided into a control group and a treatment group. The students participated in a class lecture, where one-half of the students (treatment group) sent text messages and the other half (control group) did not text. The results of the study show that the quiz scores of texting students were significantly lower than the exam scores of nontexting students. We also performed additional analyses on the impact of texting using gender and GPA. The results show that regardless of gender or GPA, grade performance is lower when multitasking takes place in a learning environment.

Our results are similar to the results found by neuroscientists on the brain's ability to retain and effectively retrieve information under dual tasks conditions. These findings provide valuable information to students who think that multitasking helps them achieve more in less time. Studies show that students spend a considerable amount of time multitasking while in class and doing homework. However, multitasking in a learning environment results in lower grade performance. The results of this study provide valuable information to students, educators, administrators and other educational stakeholders about the effect of multitasking in a learning environment on students' grade performance.

Limitations

The first limitation of our study is that we used students from only one university, which may limit the generalizability of the study. Another limitation is the treatment used in the study. Texting is only one form of multitasking students performed in a learning environment. Different results may be found using other forms of multitasking such as surfing the Internet or listening to music. Both of the above limitations may limit the generalization of the study.

Future Research

There are many opportunities for future concerning multitasking in a learning environment. Technology generates many methods of communication students use for learning and social activities. Examining other forms of multitasking, such as using cell phones or computers to access social Web sites while learning, may reveal additional information on grade performance. Furthermore, a more diverse group of participants may provide additional information about multitasking and grade performance. Thus, with the expansion of technology, students will always find additional ways to multitask.

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Table 1
Demographic Characteristics of the Students (n = 62)

Variable	*Number*	*Percent*
Gender:		
Male	26	41.94%
Female	36	58.06%
Class Standing:		
Freshman	10	16.13%
Sophomore	33	53.23%
Junior	16	25.81%
Senior	3	4.84%
Major:		
Accounting	17	27.42%
Finance	6	9.68%
Management	8	12.90%
General Business	31	50.00%
GPA:		
4.0 – 3.0	36	58.06%
Below 3.0	26	41.94%

Table 2
Results: Texting versus Nontexting (n = 62)

Panel A: Texting versus Nontexting

	n	Mean	Std. Dev.	t-stat	p-value
Texting	31	42.81	9.91	1.75	.0001***
Nontexting	31	58.67	10.42		
Total	62				

Panel B: Female versus Male (Regardless of Texting)

	n	Mean	Std. Dev.	t-stat	p-value (two-tailed)
Female	36	48.61	13.76	-1.36	.1793
Male	26	53.07	11.23		
Total	62				

Panel C: Female

	n	Mean	Std. Dev.	t-stat	p-value (two-tailed)
Texting	20	41.75	10.79	3.99	.0003***
Nontexting	16	57.19	12.38		
Total	36				

Panel D: Male

	n	Mean	Std. Dev.	t-stat	p-value (two-tailed)
Texting	11	44.58	8.38	4.99	.0001***
Nontexting	15	60.36	7.71		
Total	26				

Panel E: GPA

GPA > 3.0	n	Mean	Std. Dev.	t-stat	p-value (two-tailed)
Texting	12	41.61	10.50	3.47	.0020**
Nontexting	14	59.23	10.96		
GPA < 3.0					
Texting	19	41.58	9.58	5.03	.0001***
Nontexting	17	58.23	10.29		

**p <0.05.
***p <0.01.