RUNNING TITLE: LAPTOP MULITASKING AS LACK OF SELF-REGULATION

Learning variables, in-class laptop multitasking and academic performance: A path analysis

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Abstract

This study examines the relationships among learning variables, multitasking, and academic performance. Based on a survey with 176 college students, zero-order correlations were first tested between multitasking behaviors and grade. After identifying the relevant multitasking behavior (i.e., multitasking with laptops in lecture halls), the multitasking pattern was entered into a path analysis in order to understand its impact on grade, in comparison to learning variables. It is found that in-class laptop multitasking has a negative impact on grade, with an effect size similar to the impacts of intrinsic and extrinsic motivations, although in a reversed direction. Furthermore, the path analysis shows that self-regulation behaviors are negatively associated with in-class laptop multitasking, suggesting that we should look at in-class laptop multitasking as lack of self-regulation. Finally, the results indicate that self-efficacy and extrinsic motivation influence self-regulation behaviors, implying that educators and parents need to encourage students' self-regulation of laptop multitasking behaviors through building students' senses of self-efficacy and learning motivations, instead of simply banning laptops in classrooms.

Keywords: extrinsic motivation, intrinsic motivation, laptop multitasking, self-efficacy, self-regulation behaviors

1. Introduction

The current college student population is often referred to as "digital natives" (Prensky, 2001), "the Net generation" (Palfrey & Gasser, 2008), "Homo Zappiens" (Veen & Vrakking, 2006), and many other titles that suggest young people today are immersed in new media technologies. The ubiquity, mobility, and interactivity of new media technologies define the environment which they are born to and grow up in. These new media technologies, including emails, instant messaging (IMing) tools, social networking sites (SNS), online games, and World Wide Web (WWW), become accessible almost any time any where thanks to the introduction of laptops and mobile phones (Karnowski & Jandura, 2014). The high accessibility encourages young users to simultaneously engage in multiple activities, which is called multitasking (Author, 2008). Multitasking with new media is found to be prevalent among young people (Carrier, et al., 2009; Kononova, 2013). For instance, Foehr (2006) found that young people are seldom to exclusively concentrate their attention on one activity when using a computer. Yekelis, Cummings, and Reeves (2013) reported that task switching on a computer used by university students occurred every 19 seconds, according to automatically recorded screen shots. Most activities during computer multitasking are media-based, including surfing websites, IMing, emailing, watching videos, listening to music, and so on.

In a learning context such as universities, the implementation of wireless Internet allows college students to engage in multitasking in lecture halls, classrooms, or libraries. Prior research implies that there is a negative association between new media usage and academic performance (Chen & Peng, 2008; Chen & Tzeng, 2010; Jacobson & Forste, 2011). This type of evidence is relatively indirect, showing that the use of video games (Anand, 2007), SNS (Kirschner&

Karpinski, 2010), IM (Fox, Rosen, & Crawford, 2009), cell-phone conversation and text messaging (Jacobsen & Forste, 2011) are all negatively associated with grade. Many scholars attribute the negative relationship to the multitasking tendency such new media technologies foster. For instance, Jacobsen and Forste (2011) find that two-thirds of their student respondents reported multitasking, which likely increases distraction. In another study (Kirschner & Karpinski, 2010), Facebook users are found to report having lower GPAs because Facebook use is often carried out simultaneously with other study activities. The second type of evidence, mostly based on experimental studies, provides further explanation about the detrimental effects of multitasking on learning. Multitasking increases distractibility (Levine, Waite, & Bowman, 2007) and decreases recognition and recall memory (Hembrooke & Gay, 2003; Smith, et al., 2011) as well as reading comprehension scores (Fox, Rosen, & Crawford, 2009). It is argued that the limited capacity of human cognition prevents multitaskers from performing as well as those who concentrate on one task (Author, 2010). The last and the most important type of evidence directly shows how new media multitasking influences learning. For instance, Fried (2008) suggests that in-class laptop use poses a significant distraction to both users and fellow students based on weekly surveys. This finding is confirmed in an experimental study (Wood, et al., 2011), which shows that participants in the Facebook and MSN conditions in classroom lectures perform more poorly than those in the paper-and-pencil note-taking condition. Another experimental study (Sana, Weston, & Cepeda, 2013) further confirms that multitasking with a laptop during a lecture decreases not only the multitasker's test score but also those who are in direct view of a multitasking peer. In addition, Junco and Cotton (2011) find that using Facebook and texting while doing schoolwork are negatively associated with overall college GPA.

Calderwood, Ackerman, and Conklin (2014) also find that greater negative effects on learning is linked to longer duration multitasking behaviors when students are working on their homework.

Although most of previous studies show the down side of multitasking, arguments that are skeptical of this negative view also exist. One such argument states that multitasking can help people to develop other cognitive skills whereas hurt their ability to concentrate. For example, Lui and Wong (2012) find that a higher degree of media multitasking correlates with better multisensory integration. These other cognitive skills could benefit learning. Another argument says that it depends on what people multitask for. Actually students often claim that they are multitasking to find relevant information to the lecture content and to manage their various assignments and study activities (Author, 2011), which are supposed to help with their academic performance. A recent study (Author, 2012) demonstrates that different multitasking motivations relate to different multitasking behaviors, providing partial support to the claim that what people multitask for matters. The same study also suggests that multitasking behaviors vary according to the locations in as well as the technologies with which people multitask.

However, the above thread of literature is yet to address one fundamental question: how does multitasking play its role in the holistic process called learning? What are the variables that influence students' learning activities including multitasking patterns? How does multitasking, together with other learning variables, influence academic performance? What is missing from the existing literature on multitasking and learning is the examination of the relationship among traditional learning variables, multitasking, and academic performance. Education research has recognized that academic performance measured in the format of grade is subject to a myriad of influences. Students' individual differences play important roles in affecting academic

performance. Such individual factors include both psychological variables such as learning motivations and behavioral variables such as self-regulation behaviors. Previous studies (e.g., Burgum, Martins, & Northey, 1993; Killen, 1994; Pintrich & De Groot, 1990) show that five individual learning variables are often functional in affecting grade, which are self-efficacy, test anxiety, intrinsic and extrinsic motivation, as well as self-regulation behaviors.

Self-efficacy in an educational setting refers to "learners' beliefs about their capabilities to learn or perform behaviors at designated levels" (Schunk & Ertmer, 2000). In a comprehensive review Zimmerman (2000) makes, self-efficacy is found to account for approximately 14% of the variance in students' academic performance. Self-efficacy often influences academic performance through influencing factors such as level of effort, emotional reactions, self-monitoring, self-evaluation, and others.

Test anxiety is one particular emotional reaction to taking tests or exams in a learning environment. Test-anxious students have a low response threshold for anxiety in evaluative situations, tending to view such situations as personally threatening (Zeidner, 1998, p.18). A meta-analysis of studies on test anxiety and academic performance (Seipp, 1991) finds that test anxiety has an overall negative effect with an effect size of $r = -.21$ on academic performance. In addition, some studies also observe significant relationships between test anxiety and academic motivations such as the test-anxious students are less motivated in highly evaluative classrooms compared to not-so-evaluative classrooms (Hancock, 2001).

Intrinsic and extrinsic motivations are two classic concepts in understanding learning behaviors and learning consequences. Intrinsic motivation is defined as "the doing of an activity for its inherent satisfactions rather than for some separable consequence" (Ryan & Deci, 2000).

Extrinsic motivation, in contrast, is "a construct that pertains whenever an activity that is done in order to attain some separable outcome" (Ryan & Deci, 2000). Although the relationship between motivations and academic performance was not always direct and clear-cut, many studies (e.g., Pintrich & De Groot, 1990; Baker, 2004) find that intrinsic motivation is positively related to good learning behaviors such as self-regulation and negatively related to bad emotional reactions such as stress. Extrinsic motivation, however, is found to be either irrelevant or negatively related to self-regulation behaviors (e.g., Baker, 2004).

The last learning variable this paper includes is self-regulation behaviors. Different from the above psychological variables, self-regulation behaviors are rather behaviors that are part of learning activities. These behaviors could be subject to the influences of various psychologies such as motivations, test anxiety, and self-efficacy. Although self-regulated learning includes both social cognitive and behavioral dimensions (Zimmerman, 1989), self-regulation behaviors focus on the actions and processes directed at acquiring information or skill. On one hand, self-regulation behaviors are influenced by social cognitive factors such as self-efficacy and learning motivations (e.g., Pintrich, 1999). On the other hand, self-regulation behaviors have direct influence on academic performance (e.g., Pintrich & De Groot, 1990). It is found that self-regulation behaviors such as self-evaluation and effort management have positive impact on grade.

Based on both media multitasking and education literatures, a theoretical path model was drawn to show the predicted relationships among learning variables, multitasking behaviors, and academic performance. The model is illustrated in Figure 1. The single-directional arrows indicate the direction of the causal effects hypothesized. For instance, a single-directional arrow

from self-regulation behaviors (SRB) to midterm grade indicates that SRB is expected to affect midterm grade, not the other way around. The bi-directional arrows indicate that it is not necessarily expected that there is a causal direction between the two variables. For example, the bi-directional arrows between self-efficacy (SE) and test anxiety (TA) mean that it is expected that SE and TA mutually influence each other. The small circles such as e1, e2, and e3 indicate that these are endogenous variables in the model and the model accounts for their measurement errors. Specifically, the hypotheses are listed below:

Hypothesis (1): there should be a negative association between laptop multitasking and midterm grade.

Hypothesis (2): all learning variables (i.e., test anxiety, self-efficacy, intrinsic motivation, extrinsic motivation, and self-regulation behaviors) should have direct and significant associations with midterm grade.

Hypothesis (3): all learning psychologies (i.e., test anxiety, self-efficacy, intrinsic motivation, and extrinsic motivation) also have indirect associations with midterm grade through the intervening variables, multitasking and self-regulation behaviors.

Figure 1 about here.

2. Method

2.1 Sample

One hundred twenty-seven females and 49 male college students, aged 19 to 40 years (mean = 21.55, SD = 1.94), completed the survey for this study. Students were primarily ethnic Chinese (86%) from working- and middle-class families in Singapore, with 58% of them living in a 3- or 4-room government-funded flats and 32% living in private apartments or landed properties. Students were enrolled in an introductory level class on Research Methods in a Singaporean university and received course credit for their participation. Most of the students majored in Communications and New Media. The teaching mode of this class includes a two-hour lecture in a large lecture theatre and a one-hour tutorial in smaller groups (about 20-30 students) every week.

Responses were obtained through an Internet survey service called SurveyMonkey. The survey included questions designed to measure various aspects of learning style (measures are borrowed from previous literature: Burgum, Martins, & Northey, 1993; Killen, 1994; Pintrich & De Groot, 1990), and multitasking with new media (i.e., laptops, mobile phones, MP3 players, portable game devices, and portable CD/DVD players) in various locations (i.e. lecture halls, tutorial classrooms, and outside classrooms such as in library or at home while studying). Demographic data were also obtained. The survey was executed two weeks after the midterm exam, and the exam grade were self-reported by respondents. Preliminary analyses (e.g., zero-order correlations and t-tests) show that none of the demographic variables has any significant impact on either midterm grade or multitasking behaviors[1]. In addition, among the various multitasking variables, only multitasking with laptops in lecture halls has a significant correlation with midterm grade. Therefore, the above non-significant variables were excluded from the analyses.

2.2 Measures

The endogenous variable, academic performance, is measured by self-reported midterm exam grade based on a scale from 0 to 30. Self-reported grades are found to be close to actual grades according to previous research (e.g., Dornbusch, Ritter, & Leiderman, 1987). Another reason of using self-reported grades is to make sure that the survey is completely anonymous and encourage students to honestly report their multitasking behaviors. The first intervening variable is amount of multitasking with laptops in lecture halls, which is measured by a 7-point Likert scale (1 = none, 7 = all the time). The second intervening variable is self-regulation behaviors, measured by five items. The exogenous variables are psychological variables related to learning, including test anxiety (4-item scale), self-efficacy (7-item scale), intrinsic motivation (6-item scale), and extrinsic motivation (5-item scale). All negative statements have been reverse coded before being entered into the calculations of the overall measures. The details of each of the measures can be found in the survey questionnaire attached at the end of this paper (see Appendix A). Descriptive statistics of all variables included in the path analysis model can be found in Table 1. Reliability tests for each of the scales are reported in Table 1 too.

Table 1 about here.

2.3 Analysis

Statistical analyses were conducted using Statistical Packages for the Social Sciences (SPSS) and Analysis of Moment Structures (AMOS). Aside from basic descriptive analyses (e.g., means, standard deviations, correlations, and t-tests), the main analytic technique implemented was a path analysis, which was used to determine the causal effects among learning variables, in-

class laptop multitasking, and midterm grade. Developed by Sewall Wright, path analysis is a method employed to determine whether or not a multivariate set of nonexperimental data fits well with a particular (a priori) causal model. Cases with missing values on any of the variables included in the regression models were deleted list-wise.

3. Results

Descriptive statistics of all the variables are presented in Table 1. The outcome measures indicate that the average midterm grade for the sample was 21.32 (SD = 3.32) and the respondents reported an average of 3.65 (*SD* = 2.09) out of a 7-point of Likert scale on the time they spent on multitasking with laptops in lecture halls, which roughly means that they sometimes multitask. Means and standard deviations for learning variables are also reported in Table 1. On average, the respondents display a medium amount of self-efficacy (mean = 4.13, SD = 1.24), test anxiety (mean = 3.71, SD = 1.41), intrinsic motivation (mean = 4.63, SD = 1.20), extrinsic motivation (mean = 4.63, SD = 1.18), and self-regulation behaviors (mean = 4.67, SD = 1.02).

Table 1 also shows the correlations among individual learning variables, in-class laptop multitasking behaviors, and midterm grade. Self-efficacy is positively related to intrinsic and extrinsic motivation, self-regulation behaviors, and midterm grade whereas negatively related to test anxiety. Test anxiety is positively related to extrinsic motivation but negatively related to midterm grade. Intrinsic motivation, extrinsic motivation, and self-regulation behaviors are all positively regaled to each other. Extrinsic motivation is also negatively related to laptop

multitasking. Self-regulation behaviors are positively related to midterm grade but negatively related to laptop multitasking. Finally, laptop multitasking is negatively related to midterm grade.

A path analysis was conducted to determine the causal effects among learning variables, laptop multitasking, and midterm grade. The initial model, presented in Figure 1, was not consistent with the empirical data. More specifically, the non-significant paths included self-efficacy, test anxiety, intrinsic and extrinsic motivation on laptop multitasking; test anxiety on self-regulation behaviors and midterm grade; intrinsic motivation on self-regulation behaviors; as well as self-regulation behaviors on midterm grade. These non-significant paths were thus dropped. A revised model was generated and is now presented in Figure 2. All path coefficients are now significant at the .05 level. The model fits well with a non-significant Chi-square of Minimum Discrepancy Test (9.06) and a satisfactory Normal Fit Index (.96). Root Mean Square Error of Approximation is lower than .05, which indicates good fit[2].

Figure 2 about here.

The outcome of primary interest was midterm grade: the determinant with the largest total causal effect is self-efficacy (.48), followed by intrinsic (.16), extrinsic motivations (.16), and self-regulation behaviors (.07). Laptop multitasking has a negative influence on midterm grade (-.19). Approximately 28% of variance in midterm grade is explained by the model. Another outcome of secondary interest is laptop multitasking itself: the determinant with the largest total causal effect is self-regulation behaviors (-.34), followed by extrinsic motivation (-.14) and self-efficacy (-.09). Approximately 12% of variance in laptop multitasking is explained by the model. Finally, the variable, self-regulation behaviors, is also an outcome. The determinant with the largest total causal effect is extrinsic motivation (.42), followed by self-

efficacy (.26). Approximately 28% of variance in self-regulation behaviors is explained by the model.

4. Discussion

4.1 Hypothesis (1): there should be a negative association between laptop multitasking and midterm grade.

Consistent with prior research on new media multitasking and academic performance (Fried, 2008; Junco & Cotton, 2011; Sana, Weston, & Cepeda, 2013; Wood, et al., 2011), the findings indicate that laptop multitasking is negatively associated with academic performance, after controlling for a variety of learning variables. Hypothesis one is thus fully supported. The effect size of laptop multitasking is not as large as some traditionally significant learning variables such as self-efficacy. However, the negative influence is stronger than the effects of intrinsic motivation, extrinsic motivation, test anxiety and self-regulation behaviors. Prior studies have pointed out that the negative effect of multitasking on grade has to be due to the limited cognitive capacities students have (Author, 2010). In other words, when two or more cognitive tasks are being performed simultaneously, there will be decrements in performance in at least one of the tasks. In the case of laptop multitasking during lectures, students work on not only the task of listening to and understanding the lectures but also other tasks such as note-taking, surfing webpages, searching for other information, using SNSs, IMing, and so on. The multiple tasks compete against each other for the limited cognitive capacity students possess and therefore, lead to poorer performance in a midterm exam that heavily relies on the lecture content.

In addition, this study demonstrates a specific connection between laptop multitasking in lecture halls and academic performance in a course that is based on lecturing, which suggests that whether certain kind of multitasking hurts learning also depends on the situations in which such multitasking is done. The situations can include both locations and technologies involved (see Author, 2012). First, only multitasking with the technology of laptops is found to be significantly detrimental in the current study, confirming that the call for a differentiation of the technologies used in multitasking (e.g., Wood, et al., 2011) is valid. It is because different technologies may involve different cognitive processes. Second, the negative association between multitasking with laptops and grade is only significant in the context of lecture halls but not significant in other locations such as tutorial rooms, libraries or homes. It is further argued that even for the same kind of technologies (e.g., laptops), we need to differentiate the locations in which the technologies are used (see Author, 2012). This differentiation is necessary for a number of reasons: First, locations define which tasks are being worked on simultaneously (see Junco & Cotton, 2012 for a similar argument). In the location of a lecture hall, when students multitask, they have to sacrifice their attention paid on the lectures because the cognitive processing of multiple tasks is rather synchronous. However, in the location of one's house, their multitasking behaviors may have lower detrimental effect because students can quickly switch between homework tasks and other tasks. Second, locations influence how one technology is used, in terms of the frequency and level of engagement. The frequency of using laptops in lecture halls is high because students often use laptops to take note. However, the level of engagement in other tasks such as online chats might not be high due to the classroom norm that students are supposed to concentrate on the lecture content. For another example, in the location

of tutorial rooms, students are often engaged in group activities such as discussions. Both the frequency and level of engagement might be low due to the active involvement in other activities.

4.2 Hypothesis (2): all learning variables (i.e., test anxiety, self-efficacy, intrinsic motivation, extrinsic motivation, and self-regulation behaviors) should have direct and significant associations with midterm grade.

The results show that among the five learning variables tested, three of them, namely, self-efficacy, intrinsic motivation and extrinsic motivation, have direct associations with midterm grade. Self-efficacy is the strongest predictor of midterm grade, compared to all other variables. Intrinsic and extrinsic motivations have roughly the same amount of influence on midterm grade. Test anxiety, however, does not show any significant impact on midterm grade, suggesting that the group of students examined might be very experienced with the exam format and their test anxiety does not significantly relate to their actual performance in the test. Interestingly, self-regulation behaviors do not directly associate with grade but instead, indirectly influence grade through laptop multitasking in lecture halls. This hypothesis is thus partially supported.

4.3 Hypothesis (3): all learning psychologies (i.e., test anxiety, self-efficacy, intrinsic motivation, and extrinsic motivation) also have indirect associations with midterm grade through the intervening variables, multitasking and self-regulation behaviors.

It is found that self-efficacy and extrinsic motivations have indirect associations with midterm grade through self-regulation behaviors. However, test anxiety and intrinsic motivations do not go through either of the two intervening variables. What is even more interesting is to find that self-regulation behaviors do not directly influence grade but go through laptop multitasking

in lecture halls to influence grade. This finding helps us to understand the role of multitasking plays in the holistic process of learning. It is argued that we should treat laptop multitasking in lecture halls as an indication of lack of self-regulation behaviors. Self-regulation behaviors have a negative association with in-class laptop multitasking, which suggests that the more self-regulation behaviors one performs, the less in-class laptop multitasking one is involved in.

The findings also provide some insights into why students keep multitasking with laptops if multitasking does not help with learning. The findings, consistent with prior research (Calderwood, Ackerman, & Conklin, 2014), suggest that we should look at learning psychologies such as self-efficacy and motivations to understand why students do not want to control their learning behaviors such as laptop multitasking. First, self-regulation behaviors are positively associated with self-efficacy, which suggests that those who have lower self-efficacy might as well multitask more. This finding implies that in order to elicit students' own restriction of laptop multitasking, we need to help them to build the perception that they are efficacious in actively managing their multitasking activities for the purpose of better learning. Second, self-regulation behaviors are also positively associated with extrinsic motivation. The relationship indicates that factors external to enjoying what students learn motivate the students to self-regulate their learning behaviors. We can imply that the same factors may also discourage multitasking with laptops. This finding suggests that another means to encourage students' self-regulation of laptop multitasking is through engaging external factors that motivate students to learn well. For instance, we can encourage teachers to explicitly communicate with their students regarding the potential harm of laptop multitasking. We can also inform the parents about this

potential and urge the parents to talk to their children about how to efficiently use laptops for learning.

4.4 Limitations and directions for future research

This study was designed to verify the connections between learning variables, multitasking, and academic performance. The sample is thus limited to college students who enrolled in a lecture-based introductory level class. Tests of the association between multitasking and grade should be expanded to other teaching modes (e.g., seminars) as well as other educational institutions (e.g., a non-Singaporean university) in order to fully understand the impact of multitasking with new media on learning. Although the path analysis helps with clarifying the causality claims, future research should utilize a time-sequence design to further establish the causal order (e.g. testing the relationship between self-reported multitasking behaviors measured around midterm exam and final exam grade). Finally, the survey method relies on students' self report of their multitasking behaviors. Social desirability may discourage students to report their in-class laptop multitasking behaviors. Another potential problem is the accuracy of memory when students are multitasking. The amount of multitasking may be under reported because distractions hinder students' precise memory of their multitasking behaviors. For these two reasons, we would expect that the students actually have multitasked more than they have reported. The negative relationship between in-class laptop multitasking and grade may be even stronger. Future research can take advantage of other methods such as media use diary or observational apparatus (e.g., Calderwood, Ackerman, & Conklin, 2014) to increase the accuracy of multitasking measures.

Despite these limitations, the findings generally concur with prior research (Lui & Wong, 2012; Author, 2012) in discerning the roles of specific multitasking behaviors without claiming an overall negative effect of new media multitasking. It is proposed that we need to differentiate multitasking with new media using the concept of situation, which at least includes the locations and the technologies involved in multitasking. This differentiation is critical in order to avoid misleading conclusions such as we have to ban laptops in classrooms. The findings suggest that what students do with laptops is the problem instead of simply blaming laptops. Additionally, this paper provides one alternative perspective (other than the distraction perspective), i.e., lack of self-regulation, to understand the negative side of certain multitasking behaviors. This alternative perspective enables us to think through the practical strategies dealing with laptop multitasking in learning. This paper suggests that instead of imposing external regulations such as banning laptops, educators and parents have to address the potential negative impact of laptop multitasking through building students' sense of self-efficacy and learning motivations as well as encouraging self-regulation of laptop multitasking behaviors by students themselves.

Endnotes

1. The model presented in this paper does not include GPA for both methodological and theoretical reasons. Methodologically, although GPA is significantly correlated with midterm grade, it is not significantly correlated with in-class laptop multitasking. In addition, including GPA in the path analysis shows that (1) the variable is not a significant predictor of laptop multitasking, either directly or indirectly, (2) the presence of this variable does not change the significant effects of learning variables and laptop multitasking on midterm grade, and (3) the presence of this variable decreases the overall model fit. Theoretically, GPA should be an outcome of individual capacities (e.g., IQ) and learning variables and thus, would not help us understand the role of laptop multitasking in affecting midterm grade.

2. Chi-square of Minimum Discrepancy Test (CMIN) is a test to see how discrepant the model this paper generated is compared to a saturated model, a model that contains the same number of parameters as it has observations and fits the data perfectly. In other words, this statistics indicates to what extent, the observed covariance matrix is similar to the predicted covariance matrix--that is, the matrix predicted by this paper's model. A non-significant CMIN suggests that the model is not significantly less fit than a saturated model. Normal Fit Index (NFI) shows the difference between the model and an independence model, a worst possible model that assumes that all variables are not correlated to each other. A high value of NFI indicates that the model is much better than the independence model. Statisticians have argued that NFI has to exceed .90 (Byrne, 1994) or .95 (Schumacker & Lomax, 2004). Root Mean Square Error of Approximation (RMSEA) estimates again, the lack of fit compared to the saturated model. RMSEA needs to be less than .08 (Browne & Cudeck, 1993) and ideally, less than .05 (Stieger, 1990).

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Appendix A. Survey Questionnaire.

1. Instruction

This survey is a research project conducted by Author. The research is trying to study how students multitask with media (e.g., using Facebook) and the potential effects on learning. There are no inclusion criteria so anybody can participate in this study. You will be involved in an anonymous survey taking about 20 to 40 minutes, during which you will be asked to tell us whether you multitask with media, and if yes, how and why you multitask with media and other information including your academic performance.

There are no direct benefits by participating in this research. However, your contribution will improve our knowledge about multitasking with media and its effects on learning. This knowledge will benefit not only the educators who need to understand how to make learning effective, but also the students themselves who need to learn effectively. The parents who care about their children's learning will also benefit from the findings. Participation in this study will pose no risks to participants. Questions focus on everyday activities and motives. The survey is anonymous therefore the answers would not have any influence on you.

You will get one credit for participating in this study.

The participation in this research is voluntary. Refusal to participate/ discontinuation of participation will involve no penalty to you.

If you consent to participate in this study, please click on "next page" and proceed to the main body of this questionnaire.

For an independent opinion regarding the research and the right of research participants, you may contact a staff member of the University Institutional Review Board.

2. Personal information

How old are you? （please input a number）

Are you:

Male / Female

How many years of education do you have? (please input a number)

What is your ethnicity?

Chinese

Malays

Indians

Others

Which type of housing does your family live in?

1 or 2 room HDB flats

3 room HDB flats

4 room HDB flats

5 room or executive HDB flats

Other types of HDB flats

Condominiums or private flats

Landed properties

None of above

What is your average GPA in last semester (e.g., 4.0) ？

What is your overall GPA since you joined the University (e.g., 4.0) ？

How many points did you get for the midterm exam? (e.g., 23)?

How many years of education does your mother have (Please input a number)?

How many years of education does your father have (Please input a number)?

3. Predictors of academic performance

Please indicate that to which extent, you agree with the following statements. Rate with a number ranging from 1 to 7, 1 means “Totally disagree”, 7 means “Totally agree”

Self-Efficacy

(1). Compared with other students in this class I expect to do well.

(2). I'm certain I can understand the ideas taught in this course.

(3). I expect to do very well in this class.

(4). I am sure I can do an excellent job on the problems and tasks assigned for this class.

(5). I think I will receive a good grade in this class.

(6). My study skills are excellent compared with others in this class.

(7). Compared with other students in this class I think I know a great deal about the subject.

Intrinsic Motivation

(1). An important reason why I do my class work is because I like to learn new things.

(2). I like class work best when it really makes me think.

(3). An important reason I do my class work is because I enjoy it.

(4). I do my class work because I'm interested in it.

(5). Even when I do poorly on assignments and tests I can learn from my mistakes.

(6). I think that what I am learning in this class is useful for me to know.

Extrinsic Motivation

(1). Getting good grades is extremely important to me

(2). The opportunities to succeed in my career are improved by the course.

(3). Good performance in this course helps me get entrance to another course.

(4). I feel disgraced if I don't get good grades.

(5). My parents care much about my grades.

Test Anxiety

(1). I am so nervous during a test that I cannot remember facts I have learned.

(2). I have an uneasy, upset feeling when I take a test.

(3). I worry a great deal about tests.

(4). When I take a test I think about how poorly I am doing.

Self-Regulation Behaviors

(1). Even when some parts of study materials are dull and uninteresting, I still work hard on it.

(2). I find that when the teacher is talking I think of other things and don't really listen to what is being said.

(3). I work hard to get a good grade even when I don’t like a class.

(4). I attend every lecture\tutorial even I don’t like it.

(5). I fully demonstrate my ability in assignments and research project for this class.

4. Screening question

Have you ever multitasked with media when you are studying both in and out of classrooms (e.g., SMSing friends when listening to a lecture or watching online videos when doing homework)?

Yes

No

5. Multitasking with media

Please indicate that to which extent, you agree with the following statements. Rate with a number ranging from 1 to 7, 1 means “Never”, 7 means “Always”

How often do you multitask with the following media in a lecture hall (e.g., LT 10)?

Laptops

Mobile phones

MP3 players

Portable game devices

Portable CD/DVD players

How often do you multitask with the following media in a tutorial room?

Laptops

Mobile phones

MP3 players

Portable game devices

Portable CD/DVD players

How often do you multitask with the following media when you are studying outside classrooms (e.g., in library or at home)?

Laptops

Mobile phones

MP3 players

Portable game devices

Portable CD/DVD players

Table(s)

Table 1. Means, Standard Deviations, Cronbach's alphas, and Zero-order Correlations

Variable	**M**	**SD**	**Cronbach's alpha**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Self efficacy	4.13	1.24	0.94	--	-0.31***	0.34***	0.17*	0.33***	-.05	0.44***
2. Text anxiety	3.71	1.41	0.88		--	-0.07	0.26**	0.06	0.04	-0.17*
3. Intrinsic motivation	4.63	1.20	0.92			--	0.33***	0.31***	-0.03	0.06
4. Extrinsic motivation	4.63	1.18	0.77				--	0.46***	-0.22**	0.20*
5. Self-regulation behaviors	4.67	1.02	0.69					--	-0.34***	0.22***
6. Multitasking with laptops	3.65	2.09	--						--	-0.28**
7. Midterm grade	21.32	3.32	--							--

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

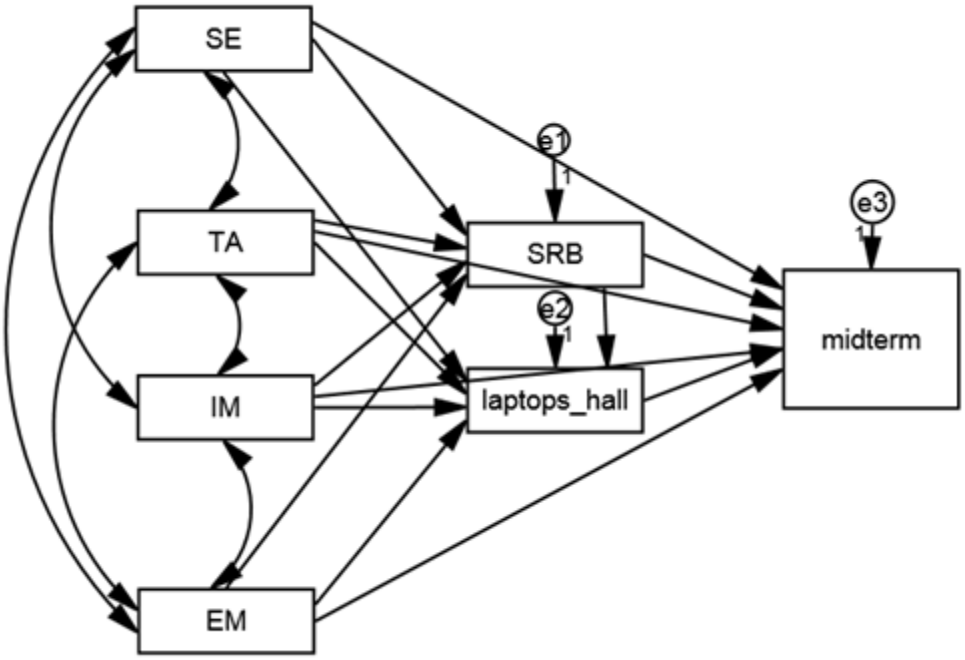
Figure 1.

Path Diagram for the Initial Model.

Figure 2.

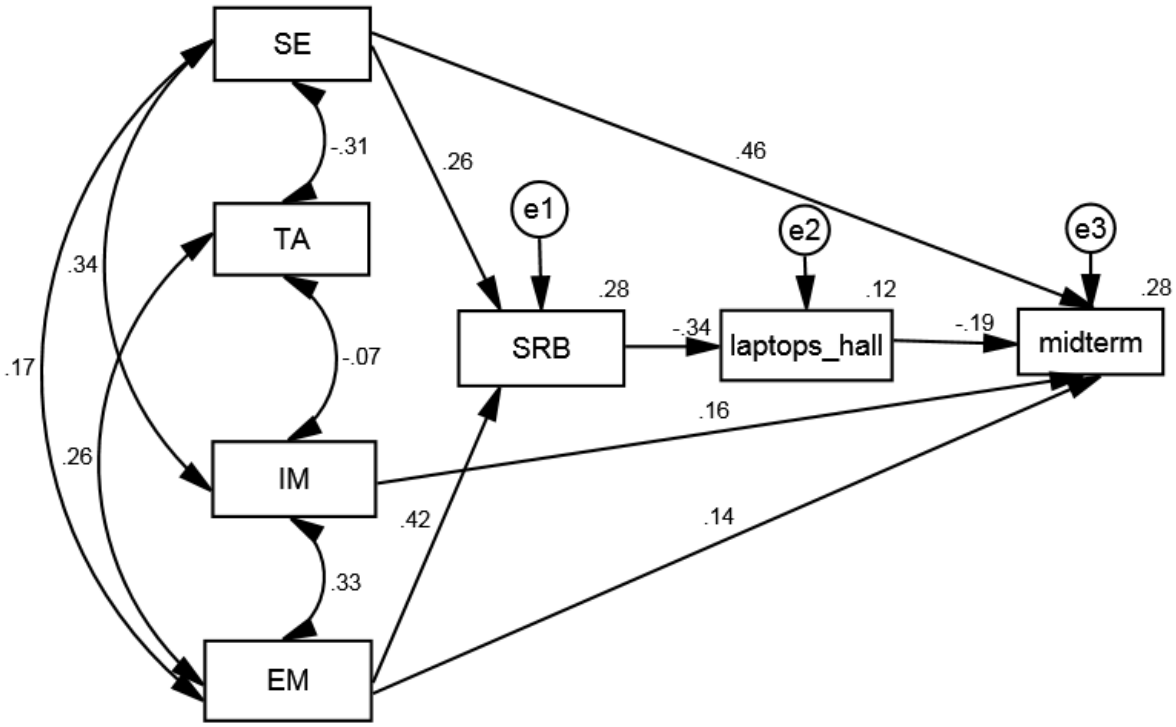
Path Diagram for the Revised Model, Including Path Coefficients.

Figure(s)



Note: SE = Self-efficacy; TA = Test anxiety; IM = Intrinsic motivation; EM = Extrinsic motivation; SRB = Self-regulation behaviors; laptops_hall = laptop multitasking in lecture halls; midterm = midterm grade.

Figure(s)



Note: SE = Self-efficacy; TA = Test anxiety; IM = Intrinsic motivation; EM = Extrinsic motivation; SRB = Self-regulation behaviors; laptops_hall = laptop multitasking in lecture halls; midterm = midterm grade.

Acknowledgments

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***Highlights (for review)**

Highlights

- In-class laptop multitasking has a negative impact on grade.
- The effect size of multitasking is similar to intrinsic and extrinsic motivations.
- Self-regulation behaviors are negatively associated with multitasking.
- The paper recommends building students' self-efficacy and learning motivations.