

Multitasking Trends and Impact on Education: A Literature Review

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Abstract—Education systems are complex and involve interactions between humans (teachers and students); media based technologies, lectures, classrooms, etc. to provide educational services. The education system performance is characterized by how well students learn, which is measured using student grades on exams and quizzes, achievements on standardized tests, among others. Advances in portable communications technologies, such as mobile phones, tablets, and laptops, created a different type of classroom, where students seem to engage in more than just the intended learning activities. The performance of more than one task in parallel or in rapid transition is commonly known as multitasking. Several operations in educational systems are performed simultaneously, resulting in a multitasking education environment. This paper surveys existing research on multitasking in educational settings, summarizes literature findings, provides a synthesis of the impact of multitasking on performance, and identifies directions of future research.

Keywords—Education systems, GPA, multitasking, performance.

I. INTRODUCTION

EDUCATION systems represent the interactions between teachers, students, technologies, lectures, classrooms, etc. to provide educational services. The goal of education is to develop the knowledge, the skills, and the character that will allow people to be accountable, to be able to work, and to participate to the well-being of the society. In addition, the purpose of education should be developed based on the need of society.

Multitasking means treating competing requests of various tasks. A task is known as “a distinct work activity carried out for a distinct purpose” [1]. Multitasking includes taking tasks in parallel or rotating between tasks (i.e., quick sequences). The main point in multitasking is that it interrupts the task, resulting in a degradation of main task performance [2].

Because the high accessibility to new portable digital advanced technologies has made it easy to use these

technologies anytime and anywhere, many people regularly access and react with technologies in every status in their lives including the classroom [3]. Students rely on smartphones, tablets, and laptops to download and use course materials and resources, but some of them use their devices in personal and social activities not related to the core education process [4]. Some studies discussed multitasking in education systems, such as [4]-[8]. These studies focused on evaluating the impact of multitasking on the performance of education systems.

Multitasking is preferred due to the pressures of increased efficiency today. The reason is due to the concept of multitasking, which is finishing more within a short period of time. This paper reviews the different interpretations of multitasking in education systems, surveys studies linked to multitasking in education environments, and the impacts of multitasking on education system outcomes.

Multitasking has been reviewed from different perspectives that are mentioned in the literature. Multitasking has been researched in an environment such as communication multitasking. In addition, measuring its performance and visual attention was another trend like evaluating the preference of multitasking on computer based on a 7-point scale [9]. In terms of multitasking in education, recent studies focused on the effect of multitasking with social network site use like Facebook on academic performance, especially with regards to exam score and grade point average (GPA) [5], [6], [10]-[14]. Multitasking with regards to safety for pedestrians has been targeted when using a mobile, listening to music to measure safety level when multitasking on streets [15]. Off-task multi-tasking with digital technologies and its effect on learning of students in lecture halls were examined [3]. Few studies mentioned the effect of training on multitasking such as the multitasking as a method of training the brain that in result can contribute to improve the performance of a task [16].

Recently, there are increased studies about multitasking in education system. A main area of concern in education multitasking is investigating the effects of multitasking using laptops and social network sites on the performance of students in terms of exam score, GPA and education [10], [12], [17]-[19].

This study seeks to review the impacts of multitasking on Education. A review of learning contexts with relation to multitasking behaviors, and some of the potential effects of these behaviors on learning practices and outcomes are discussed.

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II. MULTITASKING

People often engage in doing more than one task at the same time (multitasking). They watch TV while they are talking, talk on a mobile while driving a car, listen to music while studying, or interact with more than one site on the web simultaneously. Multitasking has been traditionally viewed as a positive characteristic. A main characteristic of multitasking is the capacity of dealing with two tasks at the same time [22]. Another characteristic of multitasking is that it can enhance the effectiveness and efficiency of managing and doing human daily activities, particularly when multitasking in simple repetitive tasks [21]. In contrast, it is known that distributing attention can affect the performance of tasks, such as the detrimental effect of using mobile while driving a car [21]. In this article, we are interested in studying multitasking in education. Investigating the relationship between learning variables, multitasking and academic performance were among the recent studies and most of them support the hypothesis of that there is a negative connection of multitasking between using laptop in class and grade [12]. Other researchers claim that playing action video games and multitasking are ways of training the brain that can contribute to improve the performance but also to over depend on media activity [16].

Multitasking has been treated with different views:

- Computer multitasking is based on interaction with multi-media devices, such as surfing websites, emailing, instant messaging, watching videos, etc. [12];
- Communication multitasking, such as instant messaging and voice communication [9];
- Multitasking related to safety deals with pedestrians multitasking when talking on the phone at the same time of crossing the street [15];
- Social network multitasking like using Facebook while studying [10];
- Academic multitasking like using laptops in lecture halls [12].

There are three core behaviors according to computer session logs of students undertaking self-directed study within an open-access computer laboratory where multitasking was much more common than focused or sequential behaviors [21].

A survey of multitasking showed state of art in healthcare systems [27]. Conclusion indicated that there are some factors affected the performance of healthcare systems that present chances for further studies to improve it [27].

The number and kinds of interruptions in the emergency department (ED) were studied [28].

Multitasking of communication was investigated in three cases: Instant messaging (IM) conversation with one partner, two IM conversations simultaneously and IM and phone conversation simultaneously [29]. The results proposed that tasks required shorter exchanges preferred multitask with IM and tasks required more discussion preferred the voice [29].

The impact of diverting attention by using Facebook during class or while studying was given in [30]. Results indicated that low test scored significantly for high Facebook users than

low users [30].

The impact of technological distractions on academic learning was examined [31]. Results showed that technological distractions appeared on students who preferred to task-switch and resulted in off-task than others. In addition, Facebook had a negative impact on GPAs for students who accessed it [31].

Multitasking in computer communication was explained by the theory of uses and gratifications and the theory of situated action [32]. Gratifications had more powerful influence compared to situational factors. However, there were obvious variations that identified kinds of computer multitasking along the situational dimension [32].

The impacts of pain in a multi-task circumference were examined [33]. Results indicated that the performance of a simultaneous or subsequent task interfered with pain, regardless of its intensity. However, these effects were weaker with low intensity pain than with high intensity pain. Switching to another task caused large interference of pain on a subsequent task than repeating the same task [33].

A multitask study was performed in healthcare simulation of 3D virtual environment to take care of patient while recording data in a 2D graphical user interface (GUI) [34]. User performance and preference both indicated that the classical interaction metaphor was more applicable than the hybrid interaction metaphor, although simulation goals accomplished sufficiently by each interaction technique [34].

A range of multitasking situations literature was reviewed which classified into either task switching or concurrent multitasking [35]. A growing minority calls attention to the benefits of multitasking in spite of a huge number on the negative impacts of it. In addition, with some evidence, multitasking behavior of some tasks could be improved with practice [35].

A multitasking software such as the Partners Clinical Application Suite (CAS) was used to facilitate the deployment, development and using of advance clinical information management applications [36].

The number of interruptions was investigated to characterize the performed EDs' tasks and it was compared with those in primary care offices [37]. Results showed that there was significant difference in the number of interruptions and multitasking between the two different health care practice environments and suggested that there were important ergonomic differences between these two work environments that might necessitate some training approaches, design priorities, and coping strategies [37].

Loads of communication on clinical staff were measured in an acute clinical setting, and described formal and informal communication events pattern [38]. Results showed that there a need for communication training which was recommended in workplaces such as EDs. The combination of interruptions and multitasking might make clinical errors [38].

How competition between providers interacts with payment system incentives when the allocation of provider effort was examined between many dimensions or 'tasks' which was not contractible [39]. The framework highlighted that they should

take account of provider multitasking [39].

A trait media multitasking index was developed to determine groups of light and heavy media multitaskers [40]. The two groups were compared along established cognitive control dimensions. Results showed that heavy media multitaskers were more susceptible to interference from irrelevant representations in memory and from irrelevant environmental stimuli [40].

Changes in the social environment in the United States over time have made changes in the multitasking skills of younger generations [41].

The number of interruption, type of interruptions and multitasking amount experienced by registered nurses (RNs) and associated patient errors were determined [42]. Nurses manage multitasking and interruptions well but there was possibility for error, and strategies were needed to decrease interruptions [42].

Patterns of work activity undertaken by ED consultants were determined [43]. ED consultants had very high hourly task rates dominated by communication and clinical activities and frequently multitask. The activity was not affected throughout the week and it was relatively constant but it was affected by role delineation and sex [43].

How RNs experience multitasking and how it is related to their everyday activities in ED were determined in [44]. Three core concepts related to multitasking emerged from the interviews are [44]:

- multitasking – an attractive prerequisite for ED care’;
- multitasking implies efficiency’ and
- multitasking is not stressful’.

Multitasking habits for graduated students were surveyed while they were doing four activities: academic reading, reading for fun, surfing the net, and watching TV [45]. Most of the students could do more than one task at the same time while half of them claim that multitasking had an effect on focusing [45].

Psychophysiological effects of mental workload in single and dual task interaction for human-computer were examined [46]. Psychophysiological measures reacted differently to task types and they did not always agree with performance or with participants’ subjective feelings [46].

A model was developed that predicted an inverted-U relationship between multitasking and performance [47]. Some multitasking improved performance while other tasks had a negative effect. In addition, Multitasking was not encouraging when accuracy in needed [47].

III. EDUCATION SYSTEM

Education systems form the relations and connections between teacher, student, content, context, and technology, which are the components of an education system, as shown in Fig. 1. In addition, higher education organizations have to use the technological growth [20]. Today’s students are expert and amazing users of technology and prefer digital media and content in their studies [21].

Because the high accessibility of new portable digital advanced technologies has made it easy to use these

technologies anytime and anywhere, many persons regularly access and react with technologies in every status in their lives including the classroom [3]. Students use smartphones, tablets, and laptops, to arrive course materials or concerning resources, but some of them use their devices in personal and social activities not related to their study [4]. In addition, Facebook is the greatest common social media website already been used by higher education organization for personal reasons [6].

Students expend a huge time using information communication technologies. They are spending almost two hours each day searching online for information [4], and the extra time to finish the reading for the students who messaged instantaneously during reading averaged 22–59% higher than the reading time for other students [17]. In addition, almost 50% of the students used technology when allowed during lectures for each class and 76.5% used at least one kind of technology in at least one session [3]. Students use laptops for academic as well as non-academic activities. Researchers are debating on the effect of this trend on students’ educational and learning outcomes. Laptop use for undergraduate students is increasingly becoming popular; it is often deemed a necessity [8].

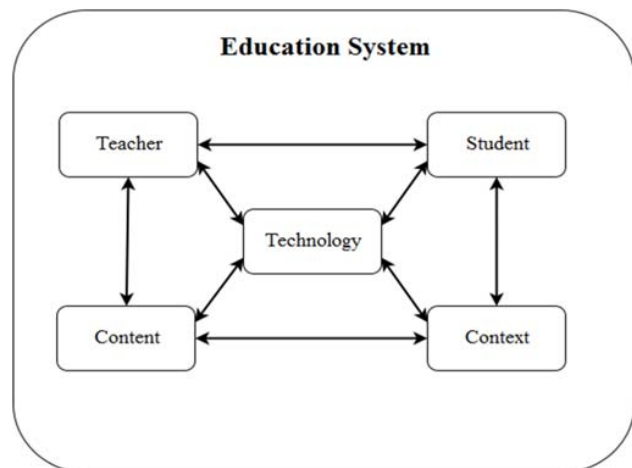


Fig. 1 Educational system components and their relations

IV. MULTITASKING IN EDUCATION

There is little literature review concerning multitasking activities related to education systems. Most studies of multitasking in education focused on educational performance. Some have focused on distraction of the students in class. Fewer studies have focused on the task switching behaviors. One trend of research in multitasking in education deals with the effect on educational performance while multitasking in the learning environment and the performance.

Using the internet and media based technologies for other purposes that are not related to the classroom affects classroom performance. Using internets at high rates were connected with lower exam scores [5] and using media based technologies in the study environment act as sources of task confusions [8] for an average of 25 minutes out of 3-hour

individual homework study session [7].

A recent study focused on the exam performance while multitasking. A comparison through an experiment was directed to test using or not using the technology affected exam performance between six different classroom environments [18]. Participants performed worst on an exam and proved a decrease in perceptions of their abilities to effectively multitask from pretest to posttest [18].

Students in an introductory psychology class were surveyed about the frequency and duration of their use of various portable devices in the classroom. Internet use negatively predicted test grades and added to the prediction of classroom learning, above a measure of intellectual ability [5].

Some studies focused on multitasking with technology and its effects on GPA. Using Social Networking Sites (SNSs) does not always decrease efficiency and productivity in an academic setting as the study done by [10]. They investigated multitasking's impact on the relationship between SNS use and GPA in United States and European university students. They found a negative relationship between SNS use and GPA that was moderated by disruptive multitasking only in the US sample and not by European students. This provided reversal results toward the impact of multitasking and using SNSs in a learning environment on university students' GPAs.

Young adults, especially college students are consistently engaging in texting, reading, and using social media while studying and attending class. The influence of media multitasking in the context of students in technology-saturated classrooms was examined to check the impacting learning and academic performance through a survey within and outside classrooms [13]. It showed that those who multitask frequently in-class have, lower current college GPAs and the same result of multitasking efficacy and time spent studying outside of class. Texting appeared as a dominant activity while attending class and doing homework, females seem to use technologies more for maintaining social connections; males seem to use technology more for the sake of online information and consuming online videos.

Research in cognitive science shows that there are clear performance decrements when trying to attend to two tasks at the same time [11]. It examined the frequency with which students multitask during class using examining the relationship between multitasking and academic performance as measured by actual overall semester GPA

Facebook is considered as 9.2% of all task cases and being displayed in 44% of lectures [4]. Time students at different class ranks spent on Facebook were examined, the time they spent multitasking with Facebook, as well as the activities they engaged in on the site [6]. The results showed that seniors spent significantly less time on Facebook and spent significantly less time multitasking with Facebook than students at other class ranks. Time spent on Facebook was significantly negatively predictive of GPA for freshmen but not for other students. Multitasking with Facebook was significantly negatively predictive of GPA for freshmen, sophomores, and juniors but not for seniors [6].

The rest of research in this trend tests the learning

performance while multitasking. IM of students while reading a typical academic psychology passage online was tested [17]. Participants were randomly assigned to one of three conditions (IM before reading, IM during reading, or no IM). It resulted in that students took significantly longer to read the passage when they IM during reading than in other conditions as such students will actually need more time to achieve the same level of performance on an academic task.

The impact of an incentive when solving problems in a multitasking situation was investigated [24]. Participants were given an incentive or not and asked to complete incremental and insight problems while either in a dual-task or single task condition followed by a surprise memory test. The findings indicated that an incentive could not improve the detrimental effects of multitasking when problem solving and might even lead to an increase in irrelevant information processing [24].

The effect of multitasking on academic works was examined [25]. Faculty members were from different universities located in some geographical regions participated to a study of four different multitasks which are using the Internet, talking with phone, watching TV or listening music, using correlational research method. It indicated that using the Internet, talking on the phone and watching TV while doing an academic work had a detrimental effect on academic works; listening music while doing a work did not result in academic delay.

The impact of multi-tasking with digital technologies while attempting to learn from real-time classroom lectures in a university setting was examined [3]. Four digitally based multi-tasking activities (texting using a cell phone, emailing, MSN messaging and Facebook) were compared to three control groups (paper-and-pencil note taking, word-processing note taking and a natural use of technology condition) over three consecutive lectures. Comparisons indicated that participants in the Facebook and MSN conditions performed more poorly than those in the paper-and pencil use control while participants who did not use any technologies in the lectures outperformed students who used some form of technology [3].

Comprehensive time-based logs of students' computer based tasks, including Facebook, during unsupervised, self-directed learning sessions were analyzed [4]. Multitasking was extremely common, 99% of sessions involved some multitasking (at least three instances of a particular task within a 20 minutes period). Facebook was the second most common task overall, accounting for 9.2% of all task instances and being present in 44% of sessions. It indicated that Facebook use is a key contributor to students' task switching and multitasking behaviors.

A web-based survey of college student technology usage was utilized to examine how IM and multitasking affected perceived educational outcomes [20]. College students used IM at high levels, they multitask while using IM, and over half report that IM has had a detrimental effect on their schoolwork [20].

Task switching and multitasking of undergraduate medical students in computer-based was studied [26]. The results

showed that male and international students were extremely like to task switch and multitask more than their female and local partners. Students who came from secondary school directly to University were extremely like to multitask more than graduate students were. Multitasking had a strong negative effect on memory encoding, which was implicated obviously in learning outcomes [26].

The relationships among learning variables, multitasking, and academic performance were examined based on a survey with college students [12]. Correlations were tested between multitasking behaviors and grade. The relevant multitasking behavior such as multitasking with laptops in lecture halls was entered into a statistical method of testing cause/effect relationships in order to understand its impact on grade, in comparison to learning variables. It resulted in that independent effectiveness and external motivation have an influence in self-regulation behaviors, implying that educators and parents need to encourage learners' self-regulation of laptop multitasking behaviors through building students' senses of independent effectiveness and learning motivations rather than banning laptops in classrooms [12].

Logs of on-campus computer and Internet usage were used to conduct a study of computer-based task switching and multitasking by undergraduate medical students [23]. A majority of students engaged in both task switching and multitasking behaviors, they did so less frequently than 'Net Generation' rhetoric implies.

Some studies investigated multitasking from the distraction point of view. The use of laptops and cell phones in the classroom is increasing but there is little research assessing whether these devices create distraction that diminishes learning. Many things could distract the students and let them multitask during the lecture. Multitasking with social media in classroom environment does not help in exam or learning performance but moreover distract sometimes in the learning process [18]. Moreover, there is a need to have an orientation programs to help promote a healthy classroom-learning environment.

A study to investigate if laptops could be distracting as educational tools inside classrooms during the learning phase of undergraduate students was done through a questionnaire [8]. It was completed by a random sample of students at a university's colleges of engineering, science, and information technology. The data analysis showed that students used laptops mainly for academic as well as non-academic purposes, which was indicative that laptops were indeed distracting tools in the classrooms.

Participant distractions were assessed with three different kinds of devices with increasing levels of potential tendency to encroach: remote surveillance cameras, a video camera, and a mobile eye tracker [7]. On average, students spent 73 minutes of the session listening to music while studying; students engaged with an average of 35 distractions of 6 seconds or longer with an aggregated mean duration of 25 minutes.

Laptops are commonplace in university classrooms. The effects of in-class laptop use on student learning in a simulated classroom were examined [19]. Participants multitasked on a

laptop during a lecture scored lower on a test compared to those who did not multitask, and participants who were in direct view of a multitasking peer scored lower on a test compared to those who were not. It demonstrates that multitasking on a laptop displays a significant distraction to both users and fellow students and can be detrimental to comprehension of lecture content.

V. DISCUSSION AND CONCLUSION

This paper examined multitasking and its impact on educational systems through the literature review. The related studies offer different methodologies toward understanding the effects of multitasking in educational settings to reflect the need for clearer recommendations for use of technology in the educational systems. The approaches used in the literature looked at students' multitasking behaviors within classroom settings, the effects and other potential explanations in the form of noticed multitasking effectiveness. Analyses of these studies offered an understanding of the relationship between multitasking and academic performance. Data show that multitasking during class has a negative influence on college GPA [6], [11]. Multitasking during class was a negatively predictive of GPA for freshmen, sophomores, and juniors but not for seniors [6]. This is inconsistent with the importance of getting students to concentrate during critical class time. Overall, the rest of the reviewed papers showed the leaning performance with multitasking. IM reported that students took significantly longer to interact in reading which extend the length of executing an academic task [17].

Current review examined the detrimental effects of multitasking in certain cases without considering activities where people would not continue texting and using social media. In addition, the current research focused on the negative impact rather than the important of the use of technology as an important skill, and the ability for being effective multitaskers. The behavior of multitasking in education related to social media were associated with low performance such as:

- A negative effect to the faculty members while multitasking on the academic work [25].
- Facebook use among college and university-aged students have been independently associated with reductions in academic performance, and students need to spend more time studying if they are multitasking [4].
- IM of college students while multitasking has had a detrimental effect on their schoolwork [20].

As the social applications offer new and innovative ways of connectivity, there will be a tendency to use smartphones, tablets and handheld devices. As the applications might change and overcome other applications. Instructors should carefully consider these outcomes when they do allow students to use technology in the classroom, and students should consider the reduction in their educational performance. Instructors should monitor closely policies and practices, guidelines, course syllabi, student handbooks, catalogs and technology training services [13]. This is consistent with previous research suggesting that multitaskers

are constantly distracted [18], [8], [7] and do not complete any task. Moreover, in consistent to previous research, the hypothesis that multitasking while doing educational activity would reduce college GPA was significantly supported [10], [13], [11], [6]. In contrast to this, students who multitask during studying may separate the time they are on social media applications or texting from time they are actually studying which leads to self-reporting that account for why the overall measure of multitasking during homework did not have a significant impact on GPA and could be part of the assignment [13].

Learning variables with relation to the multitasking and their impact on grades led to the need for building students' sense of self-regulation behaviors [12]. This study is more comprehensive and used a qualitative approach. Thus using such learning variables/resources with multitasking would enhance academic progress, and may be required to complete an assignment. The components of educational systems as shown in Fig. 1 when are in control during multitasking behavior related to class work (e.g., research online, or texting a classmate) and tasks not related to class work (e.g., social media use), the performance and detrimental impact could be improved. It is likely that use of these technologies for non-class related activities would decrease academic performance, as shown in other research [17], [10]. In this trend, it is recommended to have more measures to assess the educational performance, as the most used one in the literature are GPA and grades and thus requires more causes and effects analysis and explanations of multitasking associations, the need for the usage of technology. In addition, the control of the environments for the measures should be monitored. Thus, this gap is important for future research to control for these measure in future studies. So, more measures or outcomes with the educational systems components or controls for assessing academic performance, other subjective measures, or attitudes may comprehensively capture various forms of student learning and engagement. Future studies could consider using triangulation between quantitative and qualitative approaches to evaluate how we measure and determine academic success.

Two resource pools, the perceptual and cognitive, were competing for resources and creating bottlenecks [18]. Although the participants could switch back and forth as one thinks fit. In the Facebook, chat distraction because those participants missed information presented in the video, that multitasking distracted environment is not helping exam performance [18]. The findings from the literature review are that under the right control of structured conditions, the technology component can be used as a tool to enhance learning processes. In addition, it is apparent that social media or messaging and multitasking during academic attempt carries costs. This is consistent with the prior studies. Students who are managing busy lives may think they are accomplishing more by multitasking but actually, they all need additional time to achieve the same level of performance on an academic task [17]. Further studies will enable us to better

differentiate between learning activities that are well appropriate and not negatively impacted by multitasking.

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