College Students' Workload and Productivity for Different Types of Tasks before and during COVID-19 Pandemic in the U.S.

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Abstract: COVID-19 pandemic forces college education to be rapidly switched from face-to-face education into remote education. Two inconsistent findings exist in previous study about remote learning. First, studies before COVID-19 pandemic found remote learning is an effective method, which provided students with higher achievement and improved their work-life balance. However, studies showed remote learning during COVID-19 pandemic is not as effective as expected because of technical issues, lack of motivations and even mental health issues. Second, findings from studies about remote learning impacts on workload and productivity during COVID-19 are also inconsistent. Therefore, this study aims to quantitatively measure college students' workload and productivity during COVID-19 of different types of tasks to provide a comprehensive and latest evaluation on remote learning. The findings of this study show remote learning slightly increases college students' total listening and speaking tasks workload, total reading and writing tasks workload. Furthermore, phone call, in-person meeting, online meeting and email workload increase significantly in remote learning. However, productivity for both listening and speaking, reading and writing tasks decreases after remote learning but no significant changes of productivity are found.

Key words: college students, workload, productivity, remote learning, covid-19

1. INTRODUCTION

COVID-19 was declared as pandemic on March 11, 2020, by World Health Organization. The outbreak of COVID-19 pandemic caused serve impacts on college education system since it resulted in closure of colleges to reduce the spread of virus [1-2]. College students had to move from face-to-face education into remote learning in a quick manner. Remote learning was found easier for students to have higher achievement than face-to-face education by studies conducted before the outbreak of COVID-19 [3]. However, remote learning during COVID-19 pandemic was found less motivated than face-to-face education [4]. Therefore, a quantitative study investigating how COVID-19 impacts college students should be conducted. The impacts on college students could be quantitatively measured by workload and productivity. Workload measures how many time a student spend for each task [5] and productivity describes performance by measuring the speed of conducting a task [6]. In addition, colleges student were involved in multiple types of

tasks including listening and speaking, reading and writing [7]. Rapid changes from face-to-face learning into remote learning cause both rapid environment of learning [8] and education delivery method [9]. The changes of environment and education delivery method have different impacts on different types of tasks [8].

Therefore, this study aims to quantitatively evaluate changes of college students between face-to-face education and remote learning after the outbreak of COVID-19. The workload and productivity are used to quantitatively measure the changes. In addition, different types of tasks are considered to provide a comprehensive evaluation of COVID-19 impact on college students.

2. LITERATURE REVIEW

COVID-19 pandemic results in rapidly switching college students from face-to-face learning into remote learning. However, some inconsistent findings exist in previous studies about face-to-face learning and remote learning.

First, remote learning impacts on students were reported differently in the studies before and after the outbreak of COVID-19. The effectiveness of remote learning over face-to-face learning was reported by studies before outbreak of COVID-19. For example, students had higher achievement in remote learning than face-to-face learning in a undergraduate wellness course [3]. Also, remote learning had benefits such as improvement of work-life balance, avoiding moving because of temporary positions which lead to higher productivity [10]. However, studies after outbreak of COVID-19 reported several difficulties encountered in remote learning. Students' found remote learning was less motivated and satisfied because instructors were not preparing well for this sudden change, and technical issues such as internet issues and sudden crashes of online meeting platform [4]. In addition, mental health issues for example anxiety were faced by college students during the remote learning [11].

Second, remote learning impacts on college students' workload and productivity during COVID-19 is unclear. Some studies indicated more than 50% student in North America reported higher workload during the remote learning [10] and online learning causes higher workload and increases in stress [12]. However, students' workload change during COVID-19 pandemic is not conclusive since half students reported increased workload while half student reported no changes or even decreases in workload [13]. The productivity change was also not consistent in findings from studies about remote learning during COVID-19 pandemic. Students' productivity decreased because of lacking effective communication with instructors [14]. However, college students' productivity improved in remote learning during COVID-19 and they felt comfortable using the electronic devices [15].

This study aims to provide a comprehensive evaluation of remote learning about remote learning impacts on college students during COVID-19 pandemic, by taking impact of different tasks into consideration. Also, this study quantitatively evaluates college students' workload and productivity by measuring workload for each task in hour per week and productivity in 5-Point Likert scale.

3. METHODOLOGY

3.1. Data Collection and Data Analysis Method

The survey about study from home was distributed to in May 2020 in the U.S. by email, LinkedIn and other social media. 54 valid responses from college students were received in total. The college students include undergraduate students and graduate students. The students' demographic information, such as gender, age and majors were collected in first part. Then, students' workload (measured by hours spent per week) and productivity (measured by 5-Point Likert scale with 1 representing lowest productivity and 5 representing highest productivity) for different types of tasks

both during regular study and home-based study. The participants need to indicate their workload and productivity for both face-to-face learning (before Covid-19 outbreak) and remote learning (after Covid-19 outbreak) for five listening and speaking tasks and seven reading and writing tasks as shown in Table 1 [16].

Table 1. Task list of college students classified by listening and speaking, reading and writing

Type of Tasks	Tasks
Listening and speaking	Phone call
	In-person meeting
	Online meeting
	Other communication (text/chat/etc.)
	Presentation
Reading and writing	Email
	Review documents in print
	Prepare documents on paper
	Review documents on-screen (computers/iPads/etc.)
	Prepare documents on-screen (computers/iPads/etc.)
	Other tasks on paper (calculation/drawing/etc.)
	Other tasks on electronic devices (calculation/drawing/coding/etc.)

The data analysis consists of four steps, which are data screening, descriptive analysis of participants' demographic information, analysis of changes of workload between face-to-face learning and remote learning, and analysis of changes of productivity between face-to-face learning and remote learning. T-test with 95% confidence level is used to analyze changes in workload and productivity before and during COVID-19. The results of data screening show two of the responses are not from the U.S. and seven of their responses on the workload are much higher than these other responses which are not used in data analysis. In the end, 45 responses are used in the further analysis part.

3.2. Demographic Information Analysis

The distributions of participants' demographic information such as gender, age majors are analyzed in this part. As for the gender, 29 participants are man, who accounts for 64% of the whole participants, and 14 participants are women, which accounts for 31% of the whole participants. Also, two participants prefer not to disclose their gender information. As for the age distribution, participants' age ranges between 19 and 47 years old. 19 participants' age is between 25 and 30 years old, and 17 participants' age is between 19 and 24 years old, and nine of the participants are between 31 to 47 years old. In addition, 11 participants are undergraduate students, and 33 participants are graduate students including 15 masters' students and 18 Ph.D. student. Also, one participant is newly graduated student. As for the majors of the participants, 23 of the participants are from construction and civil engineering and 21 of the participants are from other majors such agricultural, psychology, electrical engineering etc. One participant does not clearly indicate the major.

3.3. Analysis of Workload Change

Colleges students' workload for different type of tasks is shown in Table 2. The workload for each task is measured in hour per week. The total workload for listening and speaking tasks increases 2.73 hours when college student switch from face-to-face learning to remote learning. The online meeting workload increases significantly from 0.84 hour into 4.13 hours. Also, the

workload for phone call also increases significantly from 1.93 hours to 3.51 hours. The workload for in-person meetings decreases from 5.13 hours into 0.96 hours because of the COVID-19 shutdown which provides limited chances for colleges students conduct in-person meeting. In addition, the workload for other communication (text/chat/etc.) increases 0.97 hour and the workload for presentation decreases slightly by 0.01 hour. The total workload for reading and writing tasks increases from 25.58 hours for face-to-face learning into 28.30 hours for remote learning. The workload for reviewing documents in print decreased significantly by 1.53 hours. Also, workload for preparing documents on paper reduced by 0.68 hour and workload for other tasks on paper (calculation/drawing/etc.) decreases by 0.29 hour. On the contrary, college students spend 1.07 more hours on email. Also, college students spend more time working on tasks related to screens and electronic devices. The workload for reviewing documents on-screen (computers/iPads/etc.), preparing documents on-screen (computers/iPads/etc.), other tasks on electronic devices (calculation/drawing/coding/etc.) increase by 2.18 hours, 0.64 hour and 1.33 hours respectively.

Table 2. College Student's Workload of Face-to-face Learning and Remote Learning for Different type of Tasks

Type of Tasks	Tasks	Face-to-face Learning		Remote Learning		Differences (Remote Learning Mean -Face-to-face learning mean	P-value
		Mean	SD	Mean	SD		
Listening and speaking	Phone call	1.93	2.33	3.51	4.28	1.58	0.03*
	In-person meeting	5.13	3.73	0.96	2.34	-4.18	0.00*
	Online meeting	0.84	1.43	5.21	4.13	4.37	0.00*
	Other communication (text/chat/etc.)	2.45	2.73	3.42	3.77	0.97	0.17
	Presentation	1.25	1.26	1.24	1.50	-0.01	0.97
	Total workload for listening and speaking	11.61	7.88	14.34	10.99	2.73	0.18
Reading and writing	Email	2.98	2.43	4.04	3.67	1.07	0.11
	Review documents in print	3.22	3.50	1.69	2.67	-1.53	0.02*
	Prepare documents on paper	2.08	2.33	1.40	2.80	-0.68	0.22
	Review documents on-screen (computers/iPads/etc.)	5.29	6.94	7.47	7.36	2.18	0.15
	Prepare documents on-screen (computers/iPads/etc.)	6.78	9.52	7.42	9.37	0.64	0.75
	Other tasks on paper (calculation/drawing/etc.)	1.92	2.76	1.63	2.29	-0.29	0.59

Other tasks on electronic devices (calculation/drawing/coding/etc.)	3.31	4.13	4.64	7.01	1.33	0.27
Total workload for reading and writing	25.58	17.96	28.30	18.88	2.72	0.49

3.3. Analysis of Productivity Change

College students' productivity changes between face-to-face learning and remote learning for different type of tasks are shown in Table 3. The productivity for each task is measured by five-point Likert scale. The overall productivity for listening and speaking decreases slightly by 0.24. The productivity for phone call and other communication (text/chat/etc.) improve by 0.11 and 0.04 respectively. The productivity for presentation decreases largely by 0.22, and the productivity for in-person meeting reduces by 0.13 and the productivity for online meeting declines by 0.09. The overall productivity for reading and writing tasks decreases more than listening and speaking tasks which is 0.36. The productivity for preparing documents on paper decreases most which is 0.36, then follows by other tasks on paper (calculation/drawing/etc.) which is 0.13, reviewing documents in print and other tasks on paper (calculation/drawing/etc.) which are both 0.11, and email which is 0.02. However, the productivity for reviewing documents on-screen (computers/iPads/etc.) improves by 0.18 and preparing documents on-screen (computers/iPads/etc.) increases by 0.04.

Table 3. College Student's Productivity of Face-to-face Learning and Remote Learning for Different type of Tasks

Type of Task	Tasks	Face-to-face Learning		Remote Learning		Differences (Remote Learning - Face-to-face learning	P-value
		Mean	SD	Mean	SD		
Listening and speaking	Phone call	3.91	1.20	4.02	1.29	0.11	0.67
	In-person meeting	4.44	0.97	4.31	1.65	-0.13	0.64
	Online meeting	4.22	1.51	4.13	1.04	-0.09	0.75
	Other communication (text/chat/etc.)	3.89	1.28	3.93	1.23	0.04	0.87
	Presentation	4.40	1.10	4.18	1.39	-0.22	0.40
	Overall productivity for listening and speaking	4.07	0.99	3.82	1.09	-0.24	0.27
Reading and writing	Email	4.04	0.95	4.02	0.97	-0.02	0.91
	Review documents in print	4.09	1.16	3.98	1.47	-0.11	0.69
	Prepare documents on paper	4.24	1.23	3.89	1.63	-0.36	0.25
	Review documents on-screen (computers/iPads/etc.)	3.87	1.22	4.04	1.11	0.18	0.47

Prepare documents on-screen (computers/iPads/etc.)	4.04	1.11	4.09	1.12	0.04	0.85
Other tasks on paper (calculation/drawing/etc.)	4.36	1.17	4.22	1.24	-0.13	0.60
Other tasks on electronic devices (calculation/drawing/coding/etc.)	4.31	1.24	4.20	1.27	-0.11	0.68
Overall productivity for reading and writing	4.22	1.02	3.87	1.08	-0.36	0.11

4. CONCLUSIONS AND LIMITATIONS

Findings from previous studies about remote learning impacts on colleges students are not consistent. The rapid switching from face-to-face learning to remote learning makes remote learning more challenging because several reasons. For example, instructors are not prepared well and technical issues [4]. To provide a comprehensive evaluation of COVID-19 impacts on colleges students, this study quantitively measures workload and productivity of colleges students in the U.S. before and during COVID-19. Small sample size is the limitation of this study which could be solved by distributing to more potential participants in the future.

The findings of workload analysis show the total workload for listening and speaking, reading and writing increase by 2.73 and 2.72 hours per week respectively. However, the t-test results show no statistically significant changes are found. As for the listening and speaking tasks, in-person meeting workload reduces significantly, and on-line meeting workload increases significantly. Also, the phone call workload increases significantly. As for reading and writing, workload of papers-based tasks reduces, such as reviewing documents in print, preparing documents on paper and other tasks on paper (calculation/drawing/etc.). On the contrary, workload of tasks regarding screen or electronic devices and email increase. The findings of productivity indicate minor reduction for both listening and speaking, reading and writing tasks. For listening and speaking tasks, productivity of in-person meeting, online meeting and presentation all reduce. The productivity of phone call and other communication (text/chat/etc.) increase. For reading and writing tasks, the productivity related to all paper-based tasks decrease. The productivity for reviewing documents on-screen and preparing documents on-screen both increases. The productivity for email and other tasks on electronic devices (calculation/drawing/coding/etc.) reduce as well. Furthermore, productivity for reviewing documents on-screen and preparing documents on-screen both increases, though colleges students still need speed more time in remote learning than regular learning in these two tasks, which is indicated by higher workload.

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