Computer-Supported Collaborative Work in Academics During the COVID-19 Pandemic

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Abstract: Computer-Supported Collaborative Work (CSCW) has been present as early as in the 1980's and is still being used even during the COVID-19 pandemic. This is mainly because it allows people to effectively use different collaborative platforms to work together and become more productive in their work. This study explores how CSCW affected the academic performances and group work of students during the COVID-19 pandemic. A total of forty (40) senior high school students under STEM in a private school participated in this study. Results have shown that collaborative tools enabled remote learning, allowing students to participate in group projects, discussions, and access resources regardless of their location. Students developed important collaboration skills and gained experience in communication and problem-solving. These tools also provided support and guidance from professors to students transitioning to remote learning. Moreover, CSCW tools have helped instructors assess students' understanding, offer additional resources, and provide feedback on assignments.

Keywords: collaborative work, online learning, COVID-19

1. Introduction

Computer-Supported Collaborative Work (CSCW) provides a means for students and even professionals to work collaboratively across different regions and countries. CSCW allows users to share the workload and enhance teamwork, thereby increasing productivity. It provides an ideal work environment for remote workers due to its convenience and flexibility. The demand for CSCW surged during the COVID-19 pandemic, benefiting the education sector by enabling teachers to conduct classes remotely (Talan, 2021.) CSCW's flexibility allows users to contribute collaboratively at their preferred time, pace, and location. The pandemic has prompted a massive increase in the use of collaboration tools in various work settings (Bullinger-Hoffmann et al., 2021.)

CSCW utilizes collaborative technologies like Zoom, Google Docs, and Canva to support individuals, groups, and organizations in working together on projects and research (Goff, 2022.) It is utilized in various fields such as medicine, accounting, business, multimedia, and education.

This study reviews different Computer-Supported Collaborative Work platforms for students, examines their utilization during the COVID-19 pandemic, and evaluates their effects on academic performance and the learning experience. Forty (40) Senior High School students under STEM Strand in a private school participated in the study. The study has evaluated the effectiveness of the identified tools by gathering the respondents' opinions on changes in their academic performance and collaborative work.

Cloud computing tools have emerged as valuable resources during the COVID-19 pandemic, facilitating remote work and enabling the storage and accessibility of various forms of digital data. Studies have explored the relationship between technology and work performance, emphasizing the importance of designing information and communication technologies (ICTs) based on task-technology fit principles to enhance productivity and

alleviate negative psychological outcomes among individuals working from home. Collaborative software tools have played a significant role in supporting remote work, fostering productivity, and maintaining a sense of belonging and work culture (Bullinger-Hoffmann et al., 2021.) Several organizations and institutions have shifted to online meetings, video conferences, online collaboration and online teaching where they have learned to adapt to new work and learning environments. Furthermore, studies have explored the impact of CSCW in education, with a focus on the opportunities and challenges associated with cloud computing tools, as well as the effectiveness of collaborative platforms in facilitating online collaborative learning and interaction among students and teachers (Faja, 2013.) Collectively, these findings explore the potential of cloud computing tools and online collaborative environments in strengthening information sharing, accessibility, and student engagement in various educational and professional settings, particularly during times of crisis such as the COVID-19 pandemic (Al-Samarraie et al., 2018.)

2. Related Works

2.1 CSCW During the COVID-19 Pandemic

During the COVID-19 pandemic, several studies explored the role of CSCW in academics and remote work. The study in Abelsen et al. (2021) focused on the relationship between technology and work performance. The paper suggests how designing information and communication technologies (ICTs) based on task-technology fit principles improved performance and reduced feelings of loneliness among individuals working from home. Vasilijevic et al. (2021) highlighted the significant impact of collaborative software tools in facilitating remote work, promoting productivity, and maintaining a sense of belonging and work culture. CSCW concepts and theories were reviewed by Bullinger-Hoffmann et al. (2021) emphasizing coordination support as a mechanism for efficient and reliable cooperation. Organizations have employed digital transformation during the pandemic, utilizing video conferences, digital collaboration, and online teaching and learning, which enhanced collaboration and fostered a unified campus experience. Additionally, Alharbi et al. (2021) explored the challenges faced by older adults due to pandemic-driven technology, with a focus on the usability and functionality of collaborative platforms. These studies collectively underscore the importance of task-technology fit, collaborative software tools, coordination support, and addressing the specific needs of diverse user populations in facilitating effective CSCW during the pandemic.

2.2 Online Collaborative Learning Environments

Cloud computing tools are valuable for storing and accessing digital data, ranging from simple text files to videos, serving as online libraries for both public and private use. Al-Samarraie et al. (2018) conducted a comprehensive review of several sources, categorizing cloud computing tools into Social Networking, Synchronized, and Learning Management Systems. The study outlined the opportunities and challenges associated with these tools, enabling a better understanding of their usage. Biasutti (2017) investigated the effectiveness of CSCW tools using Moodle, an online course management system. Engaging 87 students in asynchronous activities over five weeks, the study explored interdisciplinary teaching strategies and curriculum planning. Feedback collected through questionnaires highlighted the impact of collaborative tools on student interaction and learning outcomes. This convergence of research demonstrates the potential of cloud computing tools and online collaborative learning environments in facilitating enhanced information sharing, accessibility, and student engagement.

3. Methodology

In order to investigate the effectiveness of CSCW among students during the pandemic, a survey was administered to forty (40) senior high school (grades 11-12) STEM students, 60% of which are 18 years old and above. Google Form was utilized in collecting both quantitative and qualitative data on the various CSCW platforms used during the COVID-19 pandemic and its impact on their academic performance. Following the ethics guidelines of the school in the conduct of an experiment, consent forms were obtained from participants, including parental consent for minors. Additionally, ten participants were interviewed to gather further insights.

Quantitative research through a survey focuses on determining the specific collaborative platforms students used during the COVID-19 pandemic and their effects on academic and group work performances. Questions include the various collaborative platforms used, their effects on academic performance, and the factors that made them enjoyable and beneficial form the survey. The questions are based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model and its variant UTAUT2 which are considered as technology acceptance models where factors such as performance and effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit are assessed (Venkatesh, et al., 2003).

4. Results and Discussions

The survey instrument is divided into five sections: Basic Information of a respondent, Collaborative Platforms used, Utilization, Features, and Feedback. Table 1 presents the usage frequency of the different collaborative platforms. Based on the results, the top 3 platforms that are most frequently used are Zoom, Google Docs and Google Drive. Zoom is found to be the most popular platform for the following reasons: 1) free of use; 2) allows the collaborators to meet virtually, and 3) supports all the necessary features in a virtual meeting. Google Docs allows the collaborators to share and edit the same document at the same time where the revisions are reflected in real-time. Google Drive has become popular as well since collaborators can share the same drive and easily upload and revise the uploaded files.

Table 1. *Usage Frequency of Each Collaborative Platform*

Collaborative Platform	Never	Least Frequent	Less Frequent	Moderate	Frequent	Most Frequent
Google Docs	0%			1 (2.5%)	4 (10%)	**35 (87.5%)**
Microsoft 365	9 (22.5%)	6 (15%)	5 (12.5%)	9 (22.5%)	8 (20%)	3 (7.5%)
Canva	0%		2 (5%)	5 (12.5%)	13 (32.5%)	20 (50%)
Zoom	0%		1 (2.5%)	0%	2 (5%)	**37 (92.5%)**
Google Meet	2 (5%)	10 (25%)	9 (22.5%)	10 (25%)	6 (15%)	3 (7.5%)
Google Drive	0%		1 (2.5%)	4 (10%)	6 (15%)	**29 (72.5%)**
Discord	2 (5%)	3 (7.5%)	3 (7.5%)	10 (25%)	9 (22.5%)	13 (32.5%)
Notion	12 (30%)	5 (12.5%)	5 (12.5%)	6 (15%)	4 (10%)	8 (20%)
Adobe Shared Projects	24 (60%)	6 (15%)	6 (15%)	3 (7.5%)	1 (2.5%)	0%
Jamboard	2 (5%)	9 (22.5%)	12 (30%)	11 (27.5%)	4 (10%)	2 (5%)

UTAUT and UTAUT2 models are employed to measure the performance and effort expectancy, social influence, facilitation conditions, hedonic motivation, price value, and habit.

Performance expectancy is the degree to which an individual believes that using a computerized system will assist him or her in increasing his or her job performance. Out of

the 40 respondents, 39 agreed that these tools had been helpful on their education. With regard to speed in task completion when these tools are used, 85% agreed that the tools allowed them to complete their tasks faster. 75% believed that the tools made them more productive, with 22.5% remaining neutral and 2.5% to be disagreeing. Similarly, 77.5% believed that collaborative tools improved their academic performance, while 20% were neutral and the remaining have disagreed. Among the respondents, 87.5% believe that there was a change in their utilization of collaborative tools in their academic tasks, 10% were neutral, and the remaining participant did not perceive any change. Overall, results have shown that 75% and above of the participants believed that CSCW platforms were found to be helpful and effective in their education, accomplishment of tasks, productivity and academic performance.

For the *effort expectancy* factor, the results indicate that using collaborative tools and platforms requires low effort. A significant majority of the survey participants, 75%, found it easy to acquire skills in using these platforms, while 25% of the participants remained neutral. Regarding group work and collaborative activities, 85% agreed that collaborative platforms facilitated easier group cooperation. Additionally, 82.5% did not encounter difficulties in navigating through collaborative platforms, with 17.5% remaining neutral. When it comes to comfort level, 90% of respondents expressed being more comfortable using these tools, while 7.5% felt neutral and 2.5% disagreed. Finally, 87.5% agreed that collaborative tools made their learning experience during the pandemic easier, while 12.5% remained neutral. Results have shown that with CSCW platforms, at least 75% of the participants believe that with such technology, have helped them to become skillful, collaborative and navigate the such platforms.

With regard to the *social influence* on the usage of CSCW, majority of the participants, 85%, perceive that their peers have an influence on their utilization of collaborative tools and platforms. All participants unanimously agreed that their university has provided support for the use of these tools in their education. This suggests that the university services play a big role in the utilization of these platforms and in assisting the students adapt to the online learning environment during the pandemic.

For the *facilitation conditions* factor, results have shown that majority of participants, (97.5%), claimed to have the necessary resources for using collaborative tools. This is a positive finding, indicating that most participants had access to the technology and resources required. Again, support of the university on these services may have impacted the high score for this factor. Access to these resources is crucial for active participation in collaborative work and online classes. Only one participant remained neutral, possibly indicating they had access to the resources but faced difficulties in acquiring them. Additionally, 92.5% of the participants considered the use of collaborative platforms relevant and suitable for other aspects of their work, while three participants neither agreed nor disagreed. This brings to light the broader applications of these tools beyond education. A significant majority, 95% of participants, expressed their willingness to recommend these tools to others, while 5% remained neutral in their opinion.

For the *hedonic motivation* factor which is a type of motivation that aims to maximize pleasure and minimize pain, 26 participants or 65% feel more motivated to work when using collaborative tools, while the rest remained neutral in their response. However, 96% of the participants, indicated a preference for working with others through collaborative platforms compared to other modes of group work. This finding highlights that more than half of the participants recognized the value and benefits of utilizing collaborative tools when engaging in collaborative work with their peers.

85% of the participants believe that gaining access to collaborative tools is essential to their education. Results also show that all survey participants had access to collaborative tools during the COVID-19 pandemic. This may imply that students were able to adapt to the changes and challenges posed by the pandemic by having the essential tools for online learning.

For the *habi*t of using CSCW platforms, majority of the respondents i.e. 78% reported using collaborative tools not only for educational purposes but also in various fields of work. This finding suggests that collaborative tools have become integral to daily work life across

different professions. The COVID-19 pandemic likely accelerated this trend as remote work and reliance on technology for collaboration and communication increased. However, it is noteworthy that a small number of respondents had a neutral or disagreeing stance, indicating the need for ongoing evaluation and improvement of these platforms to ensure effectiveness and accessibility for all users. Additionally, 90% of the participants agreed that collaborative tools were helpful in assisting them with their work during the pandemic.

Table 2 presents the effectiveness and useful features of CSCW platforms. The most useful features of collaborative tools were identified as file sharing (100%) and screen sharing (82.5%) which facilitated document sharing and real-time collaboration. Feedback from the survey participants indicated that collaborative tools had a positive impact on their education, improving their productivity and the quality of their work. They valued the convenience, accessibility, and social interaction provided by these tools.

Table 2. *Effective and Useful Features*

Features	**Agree**
File Sharing	40 (100%)
Screen Sharing	33 (82.5%)
Internal Communication Input/ In-platform Chat	31 (77.5%)
Annotation	27 (67.5%)
Project Management	27 (67.5%)
Cloud-based File Storage	27 (67.5%)
Video Sharing	23 (57.5%)

With the qualitative data collection thru interviews, results have shown that CSCW further supported the positive experiences with collaborative tools, emphasizing their convenience and impact on performance. Technical difficulties and lack of guidance were mentioned as challenges during the pandemic. However, all interviewees recognized the essential role of collaborative tools in achieving quality education during that time.

5. Conclusion and Future Works

The COVID-19 pandemic forced educational institutions to adopt alternative modes of learning. Collaborative tools and platforms played a crucial role in mitigating the effects of this disruption on students' academic performance. This study explores how CSCW platforms have affected the academic performances and collaboration of students with fellow students during the COVID-19 pandemic.

Forty (40) STEM high school students participated in this study. Results have shown that collaborative tools enabled remote learning, allowing students to participate in group projects, discussions, and access resources regardless of their location. Students have developed important collaboration skills and gained experience in communication and problem-solving. Feedback from the survey participants indicated that collaborative tools had a positive impact on their education, improving their productivity and the quality of their work. They valued the convenience, accessibility, and social interaction provided by these tools. Moreover, these tools have provided some support and guidance from professors to students transitioning to remote learning. This had even helped the instructors assess students' understanding, offer additional resources, and provide feedback on assignments.

Furthermore, students have utilized these tools in order to stay connected with their peers during the pandemic.

However, there are limitations and areas for improvement in collaborative platforms. Accessibility and cost remain as challenges since not all students have equal access to the necessary tools and platforms. This worsens pre-existing inequalities and requires educational institutions to ensure equal access for all students. Another concern is the potential for distractions and reduced concentration during remote learning. Students need guidance and support to navigate this new learning environment effectively. Our findings highlight the importance of acknowledging and addressing the limitations of collaborative platforms in order to enhance their utilization among students in educational settings. This study serves as a stepping stone for future advancements in the field, providing guidance to platform creators on areas that require focus and improvement. Despite the lockdown in the country caused by the pandemic, students have found some means to collaborate and learn with a group through these platforms. By highlighting the necessity and benefits of CSCW in education, the study may encourage educational institutions to support and invest in these collaborative tools.

Future work may involve more students to share their experiences and thoughts on the impact of such platforms on one's academic performance and productivity.

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