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Google Classroom utilization and mathematics performance of teacher education students

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Article Info	ABSTRACT
	Google Classroom can enhance the teaching process and support students' learning. Hence, this study determines the effectiveness of Google Classroom on the respondents' mathematics performance. The study utilized 159 first-year teacher education students at Eastern Samar State University-Salcedo, selected by stratified random sampling, descriptive-comparative and correlational research design, and a questionnaire. For descriptive analysis, frequency, percentage, mean, and standard deviation were used, as t-test, ANOVA, and Pearson's correlation coefficient for comparison and relationship between variables. The study revealed that respondents owned a smartphone, which they used to connect to the internet at home and spent 1-2 hours doing internet-related activities. Respondents perceived Google Classroom as a highly effective tool for mathematics, and they had a good to excellent level of mathematics performance. Furthermore, respondents do not significantly differ in their mathematics performance based on their technological profile except for ownership of technology devices. Lastly, the study found that Google Classroom can improve students' mathematics performance. Based on the findings, it is recommended that Google Classroom be integrated into mathematics as a teaching and learning tool.

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1. INTRODUCTION

The occurrence of COVID-19 significantly challenged the educational system of the Philippines [1]. Academic activities and professional goals have been disrupted, and home teaching for students from early childhood to tertiary education has been implemented [1], [2]. As such, higher education institutions (HEIs) were mandated to look for innovative ways to deliver their mandates, especially the instruction function where face-to-face classes are not permitted. With that, professors shifted to new teaching plans, such as online learning, which tasked the professors to revise their course syllabi and requirements [3]. Some students and teachers opted for online teaching, using electronic devices and reliable internet connections. Some teachers share their lessons through Facebook, Messenger, Zoom, Google Meet, and other online platforms. Class marker, Edmodo, and the most common learning platform for digital classes is Google Classroom [4].

Google Classroom is a new tool in Google Apps for education in 2014 [5]. This classroom is a free collaboration tool where students and teachers can have conversations, and teachers can track the students' progress [6], [7]. The platform primarily aims to streamline the sharing of files between teachers and learners. Moreover, Google Classroom helps teachers create an online classroom area to manage the

documents their students need. Aside from that, it allows teachers to create assignments and exams and provide immediate constructive feedback and evaluation of the performance of the students [8].

According to Nidup [9], Google Classroom is the best instrument for enhancing teaching and learning and supports students' learning well [10]. It elevates pedagogical or cognitive instruments in transforming the focus of the classroom from teacher-centered and controlled to one that is student-centered and open to inquiry, dialogue, and creative thinking on the part of the learners as active participants [5]. Abidin and Saputro [10] likewise emphasized that Google Classroom can make students more interested in learning materials. Meanwhile, Hamad [11] states that Google Classroom provides opportunities for students to make their learning experiences more meaningful, like exploring information from digital media to acquire new ideas and build knowledge.

The study by Nguyen *et al*. [12] found that Google Classroom is effective in educating and learning, where students indicated satisfaction with learning activities through Google Classroom. Govender and Mafa [13] found that Google Classroom is a powerful tool for instruction and learning among higher education learners. Learning and acquiring skills and knowledge through Google Classroom was better than those acquired in classroom contacts. In mathematics, the study of Paisan and Sulaiman [14] found that Google Classroom can improve students' skills and creativity in solving math word problems. Orhani [8] also found that students had positive perceptions of using Google Classroom in mathematics, where Google Classroom helps them apply what is taught during math lessons. Thus, Google Classroom was a valuable platform for teaching and learning mathematical concepts.

In Eastern Samar State University-Salcedo Campus, Google Classroom was a shared learning platform used by instructors in the college of education during the pandemic to teach mathematics in the modern world. Submitting quizzes, exams, requirements, and other required outputs from the students is done through this mechanism. Feedback and conversation between the teachers and students likewise took place on this platform. With these, the researchers wanted to measure the effectiveness of Google Classroom as an online learning tool for teaching and learning mathematics in the higher education instituion and its effect on the mathematics performance of first-year teacher education students. The results of this study may also serve as a baseline to improve or strengthen the instruction function of the college and the institution as a whole. Moreover, the study addresses the gap of analysis of limited study condcuted on Google Classroom in the tertiary level.

Therefore, the study determined the effectiveness of Google Classroom utilization on the mathematics performance of teacher education students at the Eastern Samar State University-Salcedo Campus. Specifically, it answered the questions: i) what is the technological profile of the respondents in terms of devices frequently used in accessing the internet, ownership of technology devices/gadgets, internet access, and daily average time spent on internet-related activities? ii) what is the level of effectiveness of Google Classroom as a tool for teaching and learning mathematics as perceived by the respondents in terms of ease of access, usefulness, communication and interaction, instruction delivery, and student's satisfaction? iii) what is the mathematics performance of the first-year teacher education students? iv) is there a significant difference between the respondents' mathematics performance when grouped according to their technological profile? and v) is there a significant relationship between the level of effectiveness of Google Classroom as perceived by the respondents and their mathematics performance?

2.   METHOD

The study employed a descriptive-comparative and correlational research design. The study was descriptive because it describes the respondents' technological profile, level of perception of the Google Classroom effectiveness, and their mathematics performance. Likewise, the research was comparative since it tested the respondents' mathematics performance when grouped according to their technological profile. Furthermore, it was correlational because the study determined the relationship between the respondents' level of perception of the Google Classroom effectiveness and mathematics performance. The study included 159 first-year teacher education students at Eastern Samar State University-Salcedo Campus selected using stratified random sampling.

Meanwhile, an adapted survey questionnaire was utilized from Shaharanee *et al*. [5] to gather needed data. The instrument measured the effectiveness of Google Classroom as a digital platform for teaching and learning mathematics in terms of ease of access, usefulness, communication and interaction, instruction delivery, and student satisfaction. The instrument was valid and reliable, with a Cronbach alpha level greater than 0.90. A 5-point Likert-type scale format was employed to determine the effectiveness level: 5-strongly agree; 4-agree; 3-neutral; 2-disagree; and 1-strongly disagree. The data were analyzed using frequency, percentage, mean, and standard deviation for the descriptive part of the study, such as the technological profile of the respondents, level of perception of the Google Classroom effectiveness, and

mathematics performance; t-test and ANOVA for comparison of the respondents' level of perception on the Google Classroom effectiveness and mathematics performance across technological profile; and Pearson correlation coefficient for testing the relationship between the respondents' level of perception on the Google Classroom effectiveness and mathematics performance. A 5% significance was set for the t-test, ANOVA, and Pearson correlation coefficient.

3.   RESULTS AND DISCUSSION
3.1.   Technological profile of first-year teacher education students
The new study examined the respondents' technological profiles. As presented in this section, the dimensions of devices frequently used to access the internet, ownership of technology devices/gadgets, internet access, and daily average time spent on internet-related activities were considered. Table 1 presents the technological profile of first-year teacher education students at Eastern Samar State University-Salcedo Campus.

Table 1. The technological profile of the respondents

Variable	Categories	Frequency	Percentage (%)
Devices frequently used in accessing the internet	Smartphone	150	94.30
	Laptop	9	5.70
	Total	207	100.00
Ownership of technology devices/gadgets	Owned	148	93.10
	Borrowed	11	6.90
	Total	207	100.00
Internet access	Home	139	87.40
	Cybercafe/internet cafe	20	12.60
	Total	207	100.00
Daily average time spent on internet-related activities	Less than an hour	13	8.20
	1-2 hours	78	49.10
	3-5 hours	49	30.80
	More than 5 hours	14	8.80
	Do not use daily	5	3.10
	Total	159	100.00

As reflected in the Table 1, it is worth noting that most first-year teacher education students at Eastern Samar State University-Salcedo Campus used smartphones to access the internet, accounting for 150 or 94.30%. Also, 148 or 93.10% of the respondents owned a device/gadget to access the internet from home (139 or 87.40%). Meanwhile, almost half (78 or 49.10%) spent 1-2 hours doing internet-related activities. These study results imply that respondents can own or purchase a smartphone that they can utilize in their online classes because it is more affordable than a laptop. Also, respondents can provide their internet through mobile data or home Wi-Fi, which they use to complete their academic online activities.

3.2.   Respondents' level of perception of Google Classroom effectiveness
The new study investigated the respondents' perception of Google Classroom's effectiveness. This section considered dimensions of ease of access, usefulness, communication and interaction, instruction delivery, and student satisfaction. Table 2 reflects the respondents' perception of the level of effectiveness of Google Classroom as a tool for teaching and learning mathematics.
- Ease of access: as reflected in Table 2, first-year teacher education students rated Google Classroom in terms of ease of access a 3.81 mean score, implying that respondents generally find Google Classroom easy to access and user-friendly. Thus, respondents find it easy to sign in, access, send, receive, submit, navigate, and understand how the system of Google Classroom works. Moonma [15] supports the findings that Google Classroom saves time and makes it easy to submit assignments, send announcements, arranging activities like online tutoring and discussion. Moreover, students develop positive attitudes towards Google Classroom because they can easily access information anywhere and anytime through devices such as mobile phones, tablets, and laptops at any time [16], [17]. However, Tonio [18] argued that the ease of access to Google Classroom may differ based on the students' level of exposure and experience in using web-based applications and the level of internet connectivity.
- Usefulness: the Table 2 highlights that respondents agree with all the components of usefulness. Overall, the computed weighted mean is 3.89, which signifies that the application is functional and practical as a teaching-learning tool in mathematics. Similarly, Putra [17] and Kassim [19] found Google Classroom helpful in learning. Google Classroom helps to create a collaborative learning environment,

providing teacher-student and student-student interaction [20]. Students can likewise quickly get the teaching materials uploaded by the teacher [21]. Meanwhile, Al-Maroof and Al-Emram [22] argued learners prefer to use Google Classroom over other applications for they can start viewing and working on their assignments with just one click, and teachers can have a real-time viewing of student's completed assignments and tasks and can provide direct and real-time feedback and comments [23].

Table 2. Level of effectiveness of Google Classroom as a tool for teaching and learning mathematics

Statement	Mean	SD	Interpretation
Ease of access			
It is easy...			
1. Signing on the Google Classroom	3.93	0.94	Agree
2. Accessing course materials	3.81	0.94	Agree
3. Sending and receiving assignments	3.90	0.93	Agree
4. Submitting assignment	3.91	0.94	Agree
5. Navigating the system	3.64	0.86	Agree
6. Understanding the system	3.70	0.89	Agree
Weighted mean	3.81	0.78	Easy
Usefulness			
1. The quality of learning activities was excellent	3.82	0.86	Agree
2. Google Classroom is an excellent medium for social interaction (lecturer vs students and student vs student)	3.75	0.92	Agree
3. Google Classroom helps me to submit assignments on time	3.98	0.93	Agree
4. The course activities helped me to examine issues, to evaluate new ideas, and to apply what I have learned	3.94	0.88	Agree
5. The feedback provided by my professor is useful	4.03	0.95	Agree
6. The grading system in Google Classroom helps in monitor my performance and understand the current topic discussed	3.94	0.99	Agree
7. The subject objective, assessment, and content were consistent with the aid of Google Classroom	3.76	0.86	Agree
Weighted mean	3.89	0.75	Useful
Communication and interaction			
1. I felt comfortable conversing through this medium with my professor and classmates	3.60	0.86	Agree
2. My professor helped to keep course participants engaged and participating in productive discussions	3.78	0.93	Agree
3. I felt comfortable interacting with other participants during activities	3.63	0.94	Agree
4. My point of view was acknowledged by other participants during activities	3.97	0.83	Agree
5. My professor is enthusiastic about teaching and explaining via Google Classroom	3.84	0.89	Agree
6. My professor is friendly, approachable, and could be easily contacted	3.96	0.78	Agree
Weighted mean	3.80	0.77	Very good
Instruction delivery			
1. My professor provided clear instructions on how to participate in course learning activities	4.13	0.93	Agree
2. My professor communicated important due dates/time frames for learning activities	4.05	0.98	Agree
3. My professor communicated important course topics	4.13	0.93	Agree
4. My professor helped keep the course participants on task	4.08	0.89	Agree
5. My professor provided feedback that allowed me to better understand the content of the course	4.30	0.88	Strongly agree
Weighted mean	4.14	0.86	Very good
Student's satisfaction			
1. The subject met my personal goal through the medium introduced	3.81	0.84	Agree
2. I would recommend this method of learning to be applied to another appropriate subject	3.86	0.90	Agree
3. Google Classroom is my first choice for active learning compared to other methods	3.69	0.96	Agree
4. I like the Google Classroom as a learning initiative and motivation booster	3.69	0.97	Agree
Weighted mean	3.76	0.80	Satisfied
Overall weighted mean	3.88	0.90	Highly effective

- Communication and interaction: the respondents rated Google Classroom in terms of communication and interaction with a mean score of 3.80, implying that first-year teacher education students at Eastern Samar State University-Salcedo Campus consider Google Classroom as a very good tool for conversing and interacting with each other, creating meaningful interface opportunities for learners to be stayed connected and motivated. Strugar *et al.* [24] emphasized that Google Classroom is one of the number of learning management system (LMS) that offer different possibilities that can be used to improve communication among the parties and to improve the learning process. In support of the e-learning method, educators can increase the intensity of interactive communication with students even outside the official study hours [25].

- Instruction delivery: regarding instruction delivery, the respondents rated Google Classroom as very good, with a mean score of 4.14. Generally, first-year teacher education students consider Google Classroom as a good learning support tool in delivering the lesson. Salavati [26] emphasized that digital technologies in education are applied to complement the traditional approach to teaching. Subandi *et al.* [25] argued that the e-learning method provides both educators and students ease and smoothness of the lecturing process. It allows educators to give students access to scientific references that may not be available during study hours or practicum. In addition, Google Classroom can save time because it can be accessed anywhere and anytime, enabling lecturers to provide tasks or information to students and upload learning materials.
- Student's satisfaction: along with students' satisfaction, all components were rated agreeable. The computed weighted mean is 3.76, implying that first-year teacher education students generally find Google Classroom satisfying. The new study's finding conforms with the Strugar *et al.* [24] study, where students who are satisfied with the use of Google Classroom as an LMS and perceive it as having high quality are more likely to use it in the future.
- The overall effectiveness of Google Classroom: the table likewise presents the overall effectiveness of Google Classroom. It is worth noting that respondents rated the overall effectiveness of Google Classroom with a 3.88 mean score, implying that the application was a highly effective tool in the teaching-learning process of mathematics. Hussaini *et al.* [27] proved in their study that Google Classroom enhances the teaching-learning process and is an effective and efficient online learning tool.

3.3. Mathematics performance of first-year teacher education students

The study also investigated the mathematics performance of the respondents. Table 3 presents the mathematics performance of first-year teacher education students measured through their final grades in the course mathematics in the modern world. The predicted academic performance results were against the university's grading system.

It can be noted from the Table 3 that 60 or 37.70% of the respondents garnered a final grade in mathematics in the world of 1.60-2.00 and 2.10-2.50, interpreted as very good and good, respectively. Meanwhile, 38, or 23.90%, had a final grade of 2.60-3.00 with a qualitative description of fair, and only 1 or 0.60% had an excellent mathematics performance with a final grade of 1.10-1.50. This study result implies that respondents have attained from good to very good state or level of skill, depth of knowledge, and proficiency in learning mathematics. Thus, they have an average degree of mathematical literacy to formulate, employ, and interpret mathematics in various contexts to describe, predict, and explain phenomena, and recognize mathematics's role in the world.

Table 3. Mathematics performance of first-year teacher education students

Academic performance	Rating	Frequency	Percentage (%)
Excellent	1.10-1.50	1	0.60
Very good	1.60-2.00	60	37.70
Good	2.10-2.50	60	37.70
Fair	2.60-3.00	38	23.90
Total		159	100.00

Note: 1.00=oustanding; 1.10-1.50=excellent; 1.60-2.00=very good; 2.10-2.50=good; and 2.60-3.00=fair.

3.4. Difference between respondents' mathematics performance when grouped according to their technological profile

Table 4 presents the difference between the respondents' mathematics performance across their technological profiles. It is reflected that when respondents are grouped according to their technological profile, there is no significant difference in their mathematics performance in terms of device frequently used in accessing the internet (p=0.558), internet access (p=0.139), and daily average time spent for internet related activities (p=0.559). This result signifies that regardless of device, ownership status, and time spent using the internet cannot significantly affect a learner's math performance. This result contradicts Wang *et al.* [28], who found in their study that smartphones used by the students for academic purposes helped them to improve their classroom performance. The learners broaden their academic information through access to online resources [29]. However, Felisoni and Godoi [30] argued that more time spent on smartphones can result in less academic performance because of distraction as time is spent more on social media than on studies.

On the other side, a significant difference was noted in ownership of technology devices/gadgets (p=0.016). This implies that mathematics performance can be better if the learner owns a device/gadget rather than borrowing from someone. Wang *et al.* [28] emphasized that using personal digital devices

enabled students to improve their academic achievements and classroom performance because it helps them be directly connected to educational resources, access news, calls, instant messaging, surfing, social media, and data storage for school-related activities.

Table 4. Difference between respondents' mathematics performance when grouped according to technological profile

Dependent variable	Independent variable (technological profile)	Categories	Mean	t-value/ F-value	p-value ($\alpha=0.05$)	Interpretation
Mathematics Performance	Devices frequently used in accessing the internet	Smartphone	2.23	0.587	0.558	Not significant
		Laptop	2.31			
	Ownership of technology devices/gadgets	Owned	2.51	2.428	0.016	Significant
		Borrowed	2.22			
	Internet access	Home	2.11	1.488	0.139	Not significant
		Cybercafe/internet cafe	2.25			
	Daily average time spent for internet-related activities	Less than an hour	2.29	0.750	0.599	Not significant
		1-2 hours	2.23			
		3-5 hours	2.20			
		More than 5 hours	2.26			
		Do not use daily	2.50			

3.5. Relationship between the effectiveness of Google Classroom and the respondents' mathematics performance

Using Pearson correlation coeifficient, the relationship between respondents' perception of the effectiveness of Google Classroom and their mathematics performance produced an index of correlation of 0.533 with a p-value of 0.003, indicating a significant relationship between the variables. This result implies that with Google Classroom; the students' mathematics performance can be enhanced. The result of the study is supported by Abidin and Saputro [10], who emphasized that Google Classroom has the potential to support students' learning. Likewise, Orhani [8] found a positive and moderate correlation between the benefits of the Google Classroom to learning mathematical concepts. Thus, using this platform in mathematics offers an improvement in the quality of teaching and learning.

4.   CONCLUSION

The researchers conclude that first-year teacher education students of Eastern Samar State University-Salcedo Campus perceived Google Classroom as a highly effective tool for teaching and learning mathematics. Google Classroom can improve learners' mathematics performance. It can improve the quality of teaching and learning, especially in understanding mathematical concepts and learning mathematical skills. However, to fully maximize the full potential of Google Classroom, the researchers recommend that students and faculty members attend intensive training, seminars, or workshops on Google Classroom so that they can have a more convenient and better experience using the application. Moreover, the researchers encourage parents to invest in ownership of technological devices/gadgets such as smartphones/laptops for academic purposes. As found in the study, learners who own personal digital devices perform better in mathematics than those who do not have them. With it, learners could be connected to educational resources and do school-related activities at any time and anywhere. Lastly, it is recommended that a similar study be conducted in other disciplines.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
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CONFLICT OF INTEREST STATEMENT

The authors state no conflicts of interest regarding the publishing of this work. They certify that there were no financial, political, personal, religious, ideological, academic, or intellectual competing interests.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that supports the findings of this study are available on request from the corresponding author, [RDG]. The data, which contain information that could compromise the privacy of research participants, is not publicly available due to certain restrictions.

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