A Systematic Review of Google Classroom in Mathematics Education

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Abstract
Google Classroom is an online learning management system designed to help teachers create and manage online classrooms. Over the years, it has become an essential tool for teachers and students, transforming the way they learn and interact with each other. This study takes a systematic approach to assess the users' perspectives and perceptions towards Google Classroom and the implementation of Google Classroom in mathematics education. This study used comprehensive analysis and synthesis of 21 articles from 2018 until 2022, including full-text articles and peer review journal articles from Google Scholar and ERIC for better comparison between sources. Results of this study show that the quantitative was the most used method in exploring the users' perspective and perception towards Google Classroom and the implementation of Google Classroom in mathematics education. The results of this study show that most users hold favorable views of Google Classroom and find it compelling and has positively impacted learning outcomes. Overall, Google Classroom is a useful tool for facilitating remote learning, and its popularity is expected to rise in the coming years as the technology becomes more important in education.
Keywords: Google Classroom, Systematic Approach, Perspective, Implementation, Mathematics Education

Introduction
        The fourth industrial revolution, characterized by the integration of advanced technologies, has significantly impacted the educational system. As the world becomes increasingly digital, it is becoming more important for students to develop digital literacy skills that will enable them to thrive in the future workplace (Al-Emran & Malik, 2016). In response, there has been a significant increase in educational innovations that utilize technology to support teaching and learning activities. One of the most significant impacts has been the shift toward digital learning. With the help of digital technologies such as e-learning platforms, virtual classrooms, and online educational resources, students can now access high-quality educational content anywhere and anytime (Al-Maroof & Al-Emran, 2018).
        In Malaysia, online educational resources such as Google Classroom have become increasingly important in recent years. During the pandemic, the Malaysian government introduced the home-based learning (PdPR) initiative to ensure that students could continue

learning despite school closures (Hazliezah & Maslawati, 2020). Under this initiative, schools were required to provide online learning materials to students through various online platforms, including Google Classroom. This online platform allows teachers and students to interact and collaborate on educational materials and assignments (Apriyanti et al., 2019). The platform offers a range of features that enable teachers to create and manage assignments, distribute learning materials, and communicate with their students.

In addition, the platform has also helped promote digital literacy among students. As the world becomes increasingly digital, students need to develop digital literacy skills that will enable them to thrive in the future workplace (Halverson et al., 2017). By using digital tools and technologies to access learning materials, complete assignments, and communicate with teachers and peers, students can develop various digital skills that will be essential in the future workplace (Heggart & Yoo, 2018). For example, students can learn to navigate and use various digital tools, such as word processors, spreadsheets, and presentation software. They can also learn to collaborate online using shared documents, discussion forums, and video conferencing.

In mathematics education, the platform provides opportunities for collaborative learning (Ramdhani et al., 2019). Students can work together on assignments and projects, communicate with each other through the platform's messaging feature, and share their work with their peers. This collaborative approach allows students to learn from each other and gain a deeper understanding of mathematical concepts and applications (Northey et al., 2015). Besides, it also provides opportunities for personalized learning experiences. Teachers can use the platform to create and assign activities tailored to each student's unique needs and abilities (Henrie et al., 2015). Teachers can use different assignments and assessments that allow students to demonstrate their understanding differently.

Despite the widespread use of Google Classroom, it is important to examine how users in mathematics education perceive and utilize it during the teaching and learning process. Failing to consider users' perceptions and readiness to use Google Classroom can result in its ineffective use. Therefore, understanding users' perspectives towards Google Classroom can enhance its success in mathematics education and assist decision-makers in identifying the requirements for its implementation. Numerous empirical (Shaharanee et al., 2016b; Hemrungrote et al., 2017; Ventayen et al., 2018) research studies have been conducted to examine users' perceptions of Google Classroom and its implementation in mathematics education across various levels of educational institutions.

Despite the available research, there has been a lack of systematic reviews examining users' perceptions of and experiences with Google Classroom in mathematics education. Thus, this review aims to consolidate the findings of existing studies regarding users' perspectives, perceptions, and adoption of Google Classroom, specifically in mathematics education. First, researchers defined Google Classroom as a free online platform created by Google to enhance productivity and facilitate more meaningful teaching and learning experiences in the classroom (Barus & Simantunjak, 2020). The concept of Google Classroom is the "virtual classroom," as it provides a platform for teachers and students to interact and engage in learning activities in an online environment.

To identify relevant past research for their review, the researchers have identified two key research questions: 1) What are users' perspectives and perceptions towards Google Classroom? and 2) How can Google Classroom implemented in mathematics education? These questions will serve as a framework for selecting relevant articles for review. Once the

studies have been reviewed, the researchers will synthesize their findings to address both research questions.

Google Classroom in Education

Google Classroom is a web-based platform designed by Google Inc. for educational institutions. It was officially released on August 12, 2014, and is free for schools, non-profit organizations, and individual users. This user-friendly platform enables seamless communication between students and teachers inside and outside the classroom (Abid & Iqbal, 2018). Its primary goal is simplifying the teaching process and helping teachers stay organized. Additionally, it helps save time by eliminating the need for physical paperwork. Teachers can easily manage their classes, distribute assignments, communicate with students, and keep things organized in a systematic manner using Google Classroom (Gupta & Pathania, 2021).

In essence, Google Classroom is an online platform that provides teachers with a digital space to manage their courses and interact with students. It is a cloud-based application that enables teachers to share class materials, create assignments, grade work, and provide student feedback (Abazi-Bexheti et al., 2018). The platform is accessible from anywhere, anytime, and on any device with an internet connection. One of the primary advantages of this platform is that it allows teachers to upload lecture notes, making it easier for students to access and review class material outside of the classroom (Amadin et al., 2018). Additionally, teachers can generate assignments and set deadlines for their students, which helps to keep everyone on track.

Hulse (2019) explains that Google Classroom is a platform designed to streamline the paperless organization, collection, and grading of assignments. It includes various time-saving features, such as automatically creating a Google document copy for each student, making it easier for teachers to manage and track assignments (Esteban-Millat et al., 2018). The platform also provides students with a centralized location to view and track their assignments. Teachers can easily monitor assignment progress and provide direct feedback to students in real-time (Nursyahrina et al., 2021). The platform is accessible from any device, allowing students to work on assignments from anywhere. The platform also sends notifications and reminders to teachers and students when new content is added, ensuring everyone stays current.

In addition, Google Classroom's interface is designed to be simple and intuitive, with a layout that is easy to navigate for both teachers and students (Singh et al., 2020). This makes it an attractive option for teachers who may not have extensive technology experience or are just starting to explore digital tools for teaching. The platform provides clear instructions and prompts for creating and managing classes, assignments, and discussions, which can help teachers save time and stay organized (Okmawati, 2020). Additionally, Google Classroom is designed to integrate seamlessly with other Google tools, such as Google Docs, Sheets, and Slides, which many teachers and students already know. This further simplifies the learning curve and allows a more streamlined experience for teachers and students.

Regarding the attitudes toward Google Classroom, Heggart and Yoo (2018) and Syakur (2020) studies indicated that students had positive attitudes toward the use of Google Classroom in their learning. This was due to the convenience of accessing information from various devices, such as laptops, tablets, and mobile phones. Al-Maroof and Emran (2018) found that students were more motivated when Google Classroom was integrated into their learning. Sukmawati and Nensia (2019) observed that students perceived it as a tool that

fosters collaboration and interaction between teachers and students and among students. A study by Alim et al (2019) also found that students were satisfied with Google Classroom as a platform for learning.

In conclusion, Google Classroom is a digital platform that provides teachers and students with a user-friendly and efficient tool for teaching and learning. It enables teachers to organize and manage their classes, create and collect assignments, communicate with students, and provide real-time feedback. Students can access course materials, complete assignments, and interact with their teachers and peers from anywhere and anytime using various devices. Research has shown that students are highly satisfied with using Google Classroom in their learning, finding it motivating, collaborative, and convenient. With its many features and benefits, Google Classroom has become a popular choice for teachers looking to implement digital technology in their classrooms.

Method

A systematic review was conducted in this study to select previous studies related to the field of Google Classroom in mathematics education. The process involved a systematic search of related databases, namely ERIC and Google Scholar, for four months, from September 2022 to January 2023. This literature analysis aimed to create a structured and reproducible review using guidelines proposed by Khan (2003), which have been helpful for researchers to critically analyze, evaluate, and synthesize complex ideas. Figure 1 illustrates the various phases involved in conducting a systematic literature review.
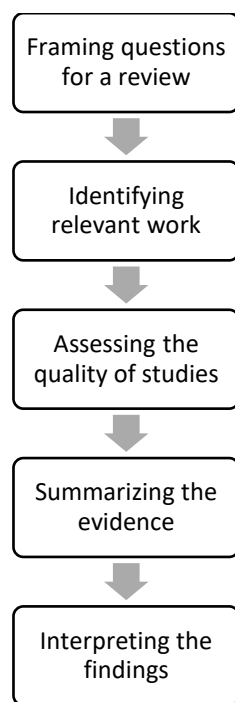
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Figure 1: Phase in Systematic review

Phase 1: Framing Questions for A Review
The review questions in this study were developed by searching for relevant questions and topics raised in previous studies. The researcher initially conducted a search to identify previous systematic reviews related to the implementation of Google Classroom, particularly in mathematics education, and its effects. However, the researcher found no studies that addressed this matter. As a result, this study was conducted to answer the following questions:
1. What are users' perspectives and perceptions towards Google Classroom?
2. How can Google Classroom implemented in mathematics education?

Phase 2: Identifying Relevant Work
The main processes involved in this phase were to collect appropriate studies during the preliminary search and assess their suitability based on inclusion and exclusion criteria. To ensure inclusivity, "grey literature" such as dissertations, conference proceedings, and book chapters was not included, which may have limitations regarding publication bias (Bernard et al., 2014). This study's search was limited to full-text articles and peer-reviewed sources. The researcher conducted an initial search using ERIC and Google Scholar over one month, using various keywords such as "google classroom in mathematics education," "implementation of google classroom in mathematics education," "effect of google classroom in mathematics education," "using google classroom in the mathematics classroom," and "application of google classroom in mathematics." The researcher considered two main features during the initial search process: the title and the abstract.

Phase 3: Assessing The Quality of Studies
To maintain the quality of this review, a study selection method was employed to identify relevant studies to be included. Inclusion and exclusion criteria were used to identify

potential primary studies, and those meeting these criteria were preferred for inclusion in this study. Therefore, the selected studies were required to meet the following inclusion criteria:

1.   Published and unpublished studies from 2018-2022.
2.   Studies that utilized a Google Classroom program in formal education.
3.   Used research methodologies.
4.   Studies that evaluated Google Classroom in mathematics education.
5.   Google Classroom as a digital tool in teaching and learning.

In addition, exclusion criteria were used to identify articles that were not relevant and should not be included in this study. The following exclusion criteria were applied:

1.   Google Classroom is not implemented in mathematics education.
2.   The articles were not published in 2018-2022.
3.   The studies did not evaluate Google Classroom.
4.   Google Classroom is not a teaching and learning tool.
5.   Other than journal articles.

This study utilized a total of five (5) inclusion and exclusion criteria that were based on the review questions. These criteria were deemed essential as they determined the scope and validity of the systematic review results. The selection process involved applying these criteria from the initial evaluation to the final stage of classifying the studies.

Phase 4: Summarizing the Evidence

This review utilized Google Scholar and ERIC as literature databases to identify relevant studies. The researchers conducted a search using various key terms such as "google classroom in mathematics education," "implementation of google classroom in mathematics education," "effect of google classroom in mathematics education," "using google classroom in the mathematics classroom," and "application of google classroom in mathematics." A total of 305 studies published between 2018 and 2022 were identified through both databases, with 185 from Google Scholar and 120 from ERIC. The results were filtered by eliminating non-English texts and non-journal sources, leaving 152 results. Then, 104 results were eliminated as they did not provide full-text articles, and 71 did not meet the inclusion criteria, resulting in 50 duplicates being removed. Finally, the researchers identified 21 articles, which were further evaluated using the full text. The PRISMA flow chart in Figure 2 summarises the search process.
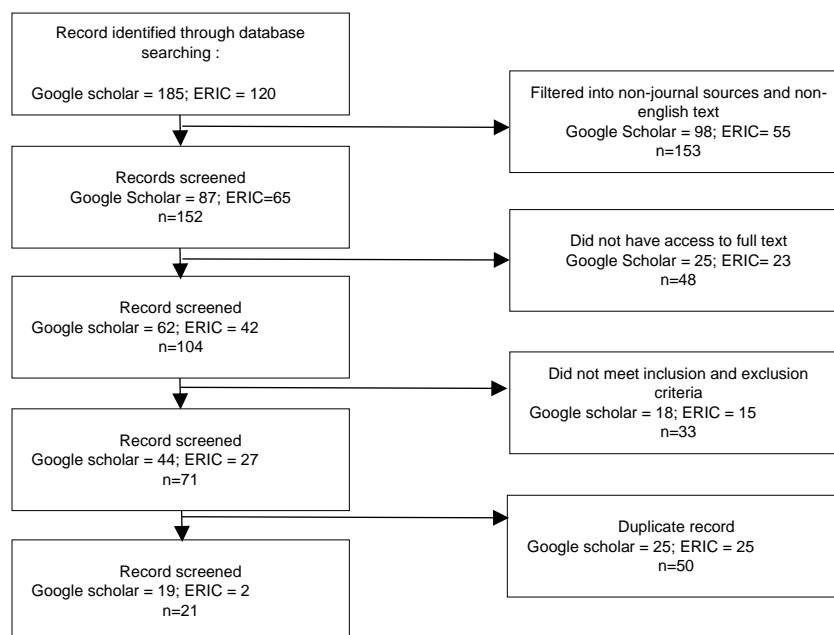
Figure 2: PRISMA flow chart

Phase 5: Interpreting the Findings

To analyze the findings, the content analysis method was employed. This method was used to identify trends in previous studies based on their categorical data, including quantitative, qualitative, and mixed methods. A systematic review of educational research published from 2018 to 2022 investigated users' perspectives and perceptions towards Google Classroom and its effects on mathematics education. Out of 305 studies identified, only 21 empirical studies met the inclusion criteria and were used to answer the research questions. Table 3 illustrates the methodology analysis from the previous publications from 2018 until 2022. From the table, the quantitative method was the most used in previous studies, followed by the qualitative and mixed methods.

Table 1

Numbers of study based on method

Methods	Google Scholar	ERIC
Quantitative	17	1
Qualitative	2	0
Mixed method	0	1

Results

User's Perspective and Perception Towards Google Classroom

Table 2 shows the viewpoints of different researchers regarding the use of Google Classroom in mathematics education. Most of these researchers have put forward a positive perspective and perception of Google Classroom as a valuable tool for teaching and learning mathematics. Their discussions are presented in the table to provide a comprehensive understanding of the benefits and drawbacks of using this platform in mathematics education.

Table 2

User's perspective and perception towards google classroom

No	Authors	Discussions
1.	(Annurwanda & Winata, 2021)	In terms of students' preparation for online learning, Google Classroom is effective in helping them learn mathematics.
2.	(Rini, 2022)	In face-to-face classes, students support offline learning more than online learning.
3.	(Azhar & Iqbal, 2018)	Google Classroom's inefficiency is primarily due to its unfriendly user interface.
4.	(Kumar et al., 2020)	The key elements impacting Google Classroom utilization from students' and instructors' perspectives were usefulness and simplicity.
5.	(Apriana & Hidajat, 2020)	The external factor, specifically the availability of engaging activities in Google Classroom learning, is thought to be extremely effective.
6.	(Yildirim et al., 2020)	Students find learning with Google Classroom effective and enjoyable because they can study material, communicate with teachers, and send assignments remotely.
7.	(Tinungki & Nurwahyu, 2020)	The implementation of Google Classroom as an e-learning platform was good, and students' reactions to the implementation were also positive.
8.	(Ari, 2021)	Students' accessibility and connectivity were the most challenging aspects of learning through Google Classroom.
9.	(Al-Maroof & Salloum, 2020)	Concentration, enjoyment, usefulness, ease of use, and satisfaction significantly impacted Google Classroom intention.
10.	(Hussein et al., 2021)	The most prominent challenge instructors faced during their Google Classroom experience was students' lack of interest.
11.	(Mailizar et al., 2021)	The two most important constructs in predicting Google Classroom use were attitude towards Google Classroom use and Google Classroom experience.

The Implementation of Google Classroom in Mathematics Education

Most studies have reported positive results regarding integrating Google Classroom into mathematics education. Table 3 provides a more detailed look at the perspectives of individual authors on implementing Google Classroom in mathematics education. This table offers insights into the benefits and limitations of using Google Classroom for teaching and learning mathematics and how it compares to other traditional teaching methods.

Table 2

Implementation of Google Classroom in mathematics education

No	Authors	Discussions
1.	(Ramadhani et al., 2019)	Flipped-Problem Based Learning on LMS-Google Classroom provides a new experience for second-year high school students.
2.	(Susilowati, 2021)	WhatsApp Groups is a slightly better online learning model than Google Classroom.
3.	(Susilo et al., 2019)	Blended learning with Google Classroom was highly influential in raising awareness of metacognition.
4.	(Suryawan et al., 2021)	The use of flipped classrooms in conjunction with Google Classroom and video conferencing improved students' learning independence and mathematics learning outcomes.
5.	(Sundary et al., 2020)	The Google Classroom-assisted Metaphorical Thinking approach has an impact on improving students' understanding of mathematical concepts.
6.	(Setiawan & Ari, 2020)	The use of audio-visual media-assisted Google Classroom affected mathematics learning outcomes.
7.	(Andriyani et al., 2022)	Regarding mathematical communication skills, the Microsoft Kaizala platform outperforms Google Classroom.
8.	(Maesaroh & Marlena, 2021)	Compared to Google Classroom, Zoom Meeting can be used as a virtual face-to-face platform to make teaching and learning more communicative and interactive.
9.	(Huda et al., 2019)	Blended Learning and E-Learning with Google Classroom influence students' understanding of mathematical concepts in the two-variable linear equation material, so it can be used as knowledge to help students understand mathematical concepts.
10.	(Pasaribu, 2021)	Students' communication skills and independence improve due to realistic mathematics learning (PMR) aided by Google Classroom.

Discussion

Previous studies have highlighted discussion on users' perspectives and perceptions of Google Classroom and also the implementation of Google Classroom in mathematics education. The results of this study show that most users hold favorable views of Google Classroom and find it effective (Yildirim et al., 2020; Tinungki & Nurwahyu, 2020; Annurwanda & Winata, 2021). The studies also suggest that the efficiency of Google Classroom is influenced by various factors, such as user interface, usefulness, simplicity, availability of engaging activities, accessibility, connectivity, concentration, enjoyment, ease of use, satisfaction, attitude, and experience (Azhar & Iqbal, 2018; Kumar et al., 2020; Apriana & Hidajat, 2020; Ari, 2021; Al-Maroof & Salloum, 2020; Hussein et al., 2021; Mailizar et al.,

2021). These factors play a critical role in determining the effectiveness of Google Classroom as a learning platform and affect the way users engage with the tool. One study showed a low perception toward Google Classroom, where students support offline learning more than online learning (Rini, 2022).

For the implementation of Google Classroom in mathematics education, the results revealed that the use of Google Classroom has positively impacted learning. According to various studies, Google Classroom has enabled new experiences for students, increased their awareness of metacognition, improved their learning independence, and enhanced their understanding of mathematical concepts (Ramadhani et al., 2019; Susilo et al., 2019; Suryawan et al., 2021; Sundary et al., 2020; Setiawan & Ari, 2020; Huda et al., 2019; Pasaribu, 2021). While most studies on the implementation of Google Classroom in mathematics education have reported positive effects on learning outcomes, a few studies did not find significant impacts. For example, Susilowati (2021) found that WhatsApp Groups are slightly better than Google Classroom. Similarly, a study by Maesaroh and Marlena (2021) found that using Zoom Meeting as a virtual face-to-face platform is more communicative and interactive.

In summary, previous studies have examined users' perceptions and implementation of Google Classroom in mathematics education, indicating that most users hold favorable views of the platform and find it effective. However, the effectiveness of Google Classroom depends on various factors, such as user interface, engagement, accessibility, and experience. Additionally, using Google Classroom in mathematics education has positively impacted learning outcomes, but some studies have not found significant effects.

Conclusion

Google Classroom is a versatile and user-friendly learning management system that has become popular among teachers and students worldwide. The application allows teachers to create and organize assignments, conduct online discussions, provide feedback, and share educational resources with their students. Additionally, it will enable students to learn at their own pace, access learning materials from anywhere, and collaborate with their peers. Overall, user perspectives towards Google Classroom are generally favorable, and most users find it effective. The platform's ease of use, accessibility, availability of engaging activities, simplicity, and user interface contribute to its effectiveness. Besides, previous studies on the implementation of Google Classroom in mathematics education have reported positive effects, including increased metacognition, learning independence, and understanding of mathematical concepts. This research can have important implications for research, policy, and practice. It can provide valuable insights into the effectiveness of Google Classroom in teaching mathematics, identify best practices and challenges, and inform policy and practice in mathematics education. Besides, this research can contribute to the field by providing evidence-based insights, identifying gaps in the literature, informing the design of professional development programs, supporting the integration of technology in mathematics education, and highlighting the importance of data-driven decision-making. Overall, Google Classroom is a valuable tool for facilitating remote learning, and its popularity is likely to grow in the coming years as technology plays an increasingly important role in education.

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