Journal of Advanced Science and Mathematics Education
Volume 4, Issue 2, 163 - 173
e_ISSN: 2798-2351
DOI: 10.58524/jasme.v4i2.532

Evaluating the sustainability of microsoft teams: Mathematics teachers' perspectives in digital learning environments

Tri Achmad Budi Susilo*
Universitas PGRI Delta, INDONESIA

Rizki Prasetya
Universias Negeri Malang, INDONESIA

Wahyu Sudrajd
Universias Kristen Cipta, INDONESIA

Abd. Syakur
Universitas PGRI Delta, INDONESIA

Article Info

Article history:

Received: July 12, 2024
Revision: Sept 02, 2024
Accepted: November 29, 2024

Keywords:

Digital Learning Environments;
Educational Technology;
Mathematics;
Microsoft Teams;
Teacher Perceptions;

Abstract

Background: The rapid adoption of technology in education has transformed the teaching and learning process, shifting from traditional classroom settings to hybrid environments that combine in-person and online learning. Microsoft Teams has become a prominent platform in digital learning, particularly during the pandemic, yet its sustainability in supporting long-term educational goals remains underexplored.
Aim: This study aims to evaluate the sustainability of Microsoft Teams in digital learning environments through the perspectives of mathematics teachers in Surabaya.
Methods: A quantitative-descriptive analytical approach was adopted. Data were collected via an online questionnaire involving 83 mathematics teachers from the Community of Mathematics Teachers (MGMP) in Surabaya. The survey examined task technology fit (TTF) and the use of Microsoft Teams' LMS in teaching practices. Descriptive statistical analysis was performed using SPSS 26 to assess the validity and reliability of the questionnaire.
Results: The findings indicate that mathematics teachers generally hold a positive perception of Microsoft Teams' sustainability in supporting digital learning. Task technology fit (TTF) significantly influenced teachers' views on the platform's effectiveness, productivity, and its impact on their teaching performance and students' outcomes. However, challenges such as technical issues and varying levels of digital literacy impacted its full potential.
Conclusion: The study concludes that incorporating Microsoft Teams as a core component of the education curriculum is vital for its long-term sustainability in digital learning environments. Recommendations include addressing existing challenges to optimize its usage and enhance its role in future educational practices.

To quote this article: Susilo, T. A. B. (2024). Evaluating the sustainability of microsoft teams: Mathematics teachers' perspectives in digital learning environments. *Journal of Advanced Science and Mathematics Education, 3* (2), 163 - 173.

INTRODUCTION

The 21st century has witnessed the integration of technology into education, leading to the rise of e-learning, a transformative approach to teaching and learning. E-learning addresses numerous challenges of traditional education systems, enhancing both effectiveness and efficiency (Moore et al., 2011; E. Hettiarachchi et al., 2015). Among the technological advancements shaping this landscape, Information and Communication Technology (ICT) is recognized as a powerful tool for educational development (Casany et al., 2012). The use of virtual learning platforms has become indispensable in creating flexible and adaptable learning environments (Ali, 2020; Finlay et al., 2022; Liu & Yu, 2023). Governments and educational institutions worldwide, including Indonesia, have been actively promoting online learning to ensure equitable access to education (Wajdi et al., 2020;

* **Corresponding author:**
Tri Achmad Budi Susilo, Universitas PGRI Delta, INDONESIA. ✉ tabsusilo05@gmail.com

Welch & Aziz, 2022). This initiative aims to bridge educational disparities by leveraging digital platforms to reach underserved communities and provide flexible learning opportunities for all students

Online learning represents a significant shift in the delivery of education, emerging as a response to the evolving demands of a globalized and technology-driven society. Online learning, defined as the delivery of educational content exclusively through the internet (Horzum, 2017; Moore et al., 2011), has revolutionized how education is conducted. By replacing face-to-face interaction with virtual engagement, it provides learners with the convenience to study from anywhere, at any time, and at their own pace (Li, 2022; V. Singh & Thurman, 2019). This mode of learning encourages collaboration, creativity, and teamwork, aligning with modern educational goals (Noushad, 2024; Hoi et al., 2021). Moreover, it allows educators to tailor content to diverse learning styles and preferences, contributing to improved learning outcomes (Chan et al., 2021). This adaptability underscores the pivotal role of online learning in shaping the future of education and preparing students for the challenges of the digital era.

Despite its benefits, online learning is not without challenges. Interaction, social presence, structure, and fulfillment are critical elements for successful e-learning experiences (Aguaded et al., 2023). Research indicates that a lack of interaction and engagement can lead to feelings of isolation, diminished confidence, and reduced patience among learners (S. Hettiarachchi et al., 2021; Xu et al., 2023). Furthermore, factors such as study behavior, motivation, and the complexity of online assessments significantly influence student performance (Hsia et al., 2016; Moscoviz & Evans, 2022; Wei et al., 2021). These challenges highlight the importance of selecting appropriate tools and platforms that foster meaningful interactions and engagement.

The evolving of digital learning demands careful selection of platforms to achieve meaningful educational outcomes. Among the numerous platforms available for online learning, Bsharat & Behak (2020) argue that Microsoft Teams has emerged as a robust tool that supports synchronous and asynchronous learning activities. Its features, including video conferencing, chat, content sharing, and assignment management, provide an interactive and collaborative learning environment (Gauthier & Husain, 2021). Microsoft Teams is particularly effective in promoting group work, discussions, and the development of soft skills, which are essential for holistic education (Ismail & Ismail, 2021; Sobaih et al., 2021). Its versatility makes it a preferred choice for educators seeking to implement dynamic and engaging instructional strategies.

Microsoft Teams' task-technology fit (TTF) plays a significant role in its perceived effectiveness. The platform's ability to align with the needs of users and the tasks they perform determines its sustainability and long-term integration in educational practices (Cardenas et al., 2021; Wea & Kuki, 2021). By facilitating collaborative learning and peer engagement, Microsoft Teams not only enhances educational outcomes but also establishes a culture of active participation and peer learning (Ilag & Sabale, 2022; Jeljeli et al 2022). However, its sustainability requires ongoing evaluation to address technical and infrastructural challenges.

Despite its strengths, Microsoft Teams faces limitations that may affect its sustainability. Issues such as a lack of adequate training for educators, internet connectivity problems, and technical glitches can hinder its effective implementation (Almaiah, 2020; Gauthier & Husain, 2021; Mesuwini & Mokoena, 2024). Additionally, certain academic tasks, such as laboratory-based teaching or essay-style responses, may not be well-supported by the platform (Sofi-Karim et al., 2023). Addressing these barriers is crucial for ensuring the platform's continued relevance and effectiveness in education.

Several studies have examined the effectiveness of digital platforms in online learning, including Moodle, Zoom, and Microsoft Teams, demonstrating their success in enhancing student engagement and learning outcomes (Jacques et al., 2021; Kansal et al., 2021; Khrisat & Fakhouri, 2024; Sobaih et al., 2021). Additionally, Microsoft Teams has been widely adopted to support collaborative learning and communication between students and teachers during the COVID-19 pandemic (Herzallah et al., 2023; Padayachee et al., 2022). Other studies have shown that blended learning approaches utilizing Microsoft Teams can improve students' learning efficiency in mathematics education (Abar et al., 2024; Mitrović et al., 2024). However, most research has primarily focused on the short-term benefits of these platforms during the pandemic.

On the other hand, studies on the long-term sustainability of these platforms in supporting digital learning, particularly from the perspective of mathematics teachers, remain limited. Herzallah et al. (2023) explored the use of Microsoft Teams for remote learning during the pandemic but did not address its potential sustainability beyond emergency periods. Sobaih et al. (2021) documented students' learning experiences with Microsoft Teams but did not specifically analyze mathematics teachers' perspectives. Furthermore, although previous research has investigated students' perceptions of Microsoft Teams, only a few studies have delved into teachers' viewpoints, particularly in subject-specific contexts like mathematics. This perspective is crucial, as teachers play a pivotal role in integrating technology into classrooms and tailoring it to their instructional needs. Other studies have highlighted the successful integration of technology into online learning. De Vera & Balgua (2023) emphasized the flexibility of digital tools like Microsoft Teams in supporting mathematics learning within dynamic environments. Singh et al. (2023) conducted an analytical survey on challenges faced during online lectures, including those using Microsoft Teams, concluding that technical quality improvements are essential for a better learning experience.

The novelty of this research lies in its focus on evaluating the sustainability of Microsoft Teams from the perspective of mathematics teachers in Surabaya. This study is particularly significant given the Surabaya Education Office's mandate for Microsoft Teams usage, necessitating an assessment of its impact and identification of areas for improvement. By analyzing the task-technology alignment of Microsoft Teams, this research offers insights into the platform's ability to support mathematics teaching, especially in aspects such as collaborative problem-solving, critical thinking, and student engagement—all core elements of mathematics education. Therefore, this study aims to bridge the gap in existing literature by exploring mathematics teachers' perceptions of Microsoft Teams as a sustainable long-term digital learning tool.

METHOD

A qualitative-descriptive analytical approach was employed in this study to identify the issues and challenges encountered in the use of Microsoft Teams for teaching and learning. This approach was selected as it allows for a systematic exploration of patterns and trends in teachers' perceptions, providing a comprehensive understanding of the factors influencing the sustainability of Microsoft Teams as a digital learning platform.

The study focused on mathematics teachers from public junior high schools in Surabaya, East Java, Indonesia, who are members of the Mathematics Teacher Community of Surabaya (MGMP Matematika Surabaya). This community was chosen as it represents a significant network of mathematics educators actively engaged in professional development and collaborative teaching practices. A Google Forms survey was distributed to 83 mathematics teachers through their WhatsApp group discussion, ensuring broad participation and accessibility.

An 18-item questionnaire, adapted from Cardenas et al. (2021), was employed for data collection. It utilized a four-point Likert scale ranging from (4) Strongly Agree to (1) Strongly Disagree, allowing teachers to express the degree of their agreement or disagreement with the provided statements. The questionnaire was structured into three sections to comprehensively address the research objectives. The first section, "Effects of Teacher Competencies on Online Learning," examined how teachers' skills and expertise influenced their use of Microsoft Teams. The second section, "Perceptions on the Use of Microsoft Teams for Teaching and Learning," focused on understanding the platform's perceived benefits, usability, and overall effectiveness. The third section, "Challenges Encountered with Online Learning," explored the difficulties teachers faced while integrating Microsoft Teams into their instructional practices.

To ensure the validity and reliability of the instrument, a rigorous evaluation process was undertaken. Internal reliability was assessed using Cronbach's alpha, which yielded a high consistency value of 0.963, indicating that the instrument was highly reliable. The questionnaire's content validity was reviewed by two educational technology experts, who assessed its clarity, relevance, and alignment with the research objectives. Items with low impact scores (<1.5) were either revised or removed, resulting in a refined 19-item questionnaire that effectively captured the intended constructs.

Descriptive statistical analysis was conducted using SPSS 26 to provide a detailed overview of the collected data. Frequencies, percentages, and means were calculated to identify trends and patterns in the teachers' responses. The results highlighted practical implications of using Microsoft Teams in mathematics instruction, offering insights into its advantages and areas requiring further development.

This study's methodological rigor ensures the reliability and validity of its findings, making it a valuable contribution to the growing body of literature on digital learning platforms. By focusing on mathematics teachers' perspectives, this research provides specific insights into the pedagogical and technological needs of educators in this subject area. The findings are expected to inform future strategies for optimizing the use of Microsoft Teams in teaching and enhancing its sustainability as a digital learning tool.

RESULTS AND DISCUSSION

This The purpose of this study was to investigate the utilization of Microsoft Teams and its long-term sustainability at public junior high schools in Surabaya, East Java, Indonesia. An online questionnaire was developed to collect data from the Mathematics Teacher Community of Surabaya (*MGMP Matematika Surabaya*), who are actively using Microsoft Teams as a teaching platform. The questionnaire was distributed to teachers currently implementing Microsoft Teams in their instructional practices, aiming to understand its effectiveness and sustainability in the context of their teaching needs.

To evaluate the information system being utilized at the junior high schools, the structured questionnaire was designed using the Task-Technology Fit (TTF) paradigm. This approach ensures a thorough assessment of how well Microsoft Teams supports the tasks required by educators in a classroom setting. The measurement items were structured around three critical constructs: the perceived impact of Microsoft Teams from a consumerization perspective, the TTF in supporting teaching and learning activities, and the projected implications for its long-term sustainability as a digital learning platform.

The questionnaire aimed to gather detailed insights into teachers' perceptions and experiences with Microsoft Teams. The perceived impact construct examined how Microsoft Teams influenced teaching efficiency and accessibility, focusing on the platform's usability and adaptability. The TTF construct explored the alignment between the platform's functionalities and the teaching requirements of mathematics educators. Lastly, the sustainability construct assessed the long-term feasibility of integrating Microsoft Teams into routine teaching practices, including its scalability and ability to meet evolving educational needs.

Data collected through the questionnaire underwent rigorous validity and reliability testing to ensure the quality of the findings. The validity of the questionnaire was confirmed through expert reviews and impact scores, ensuring that each item effectively measured the intended construct. Reliability analysis, conducted using Cronbach's alpha, indicated high internal consistency, affirming the robustness of the instrument. The findings from the analysis are presented in the following table, providing a comprehensive overview of the results.

This study provides valuable insights into the practical applications of Microsoft Teams in the education sector, particularly for mathematics instruction. By focusing on key factors such as usability, task alignment, and sustainability, the research offers recommendations for enhancing the platform's effectiveness and ensuring its continued relevance in supporting educators. The findings contribute to the growing body of knowledge on digital learning tools and their role in transforming education. The findings of the validity and reliability analyses are shown in the following table:

Table 1. Descriptive Analysis of Students' Pre-test and Post-test Results

		Frequency	Percent	Valid Percent	Cumulative Percent
X1.1					
Valid	Disagree	2	2.4	2.4	2.4
	Agree	65	78.3	78.3	80.7
	Strongly Agree	16	19.3	19.3	100.0
	Total	83	100.0	100.0	

X1.2					
Valid	Disagree	3	3.6	3.6	3.6
	Agree	68	81.9	81.9	85.5
	Strongly Agree	12	14.5	14.5	100.0
	Total	83	100.0	100.0	
X1.3					
Valid	Disagree	11	13.3	13.3	13.3
	Agree	66	79.5	79.5	92.8
	Strongly Agree	6	7.2	7.2	100.0
	Total	83	100.0	100.0	
X1.4					
Valid	Disagree	9	10.8	10.8	10.8
	Agree	63	75.9	75.9	86.7
	Strongly Agree	11	13.3	13.3	100.0
	Total	83	100.0	100.0	
X1.5					
Valid	Disagree	7	8.4	8.4	8.4
	Agree	66	79.5	79.5	88.0
	Strongly Agree	10	12.0	12.0	100.0
	Total	83	100.0	100.0	
X1.6					
Valid	Disagree	13	15.7	15.7	15.7
	Agree	64	77.1	77.1	92.8
	Strongly Agree	6	7.2	7.2	100.0
	Total	83	100.0	100.0	
X1.7					
Valid	Disagree	14	16.9	16.9	16.9
	Agree	60	72.3	72.3	89.2
	Strongly Agree	9	10.8	10.8	100.0
	Total	83	100.0	100.0	
X1.8					
Valid	Disagree	17	20.5	20.5	20.5
	Agree	61	73.5	73.5	94.0
	Strongly Agree	5	6.0	6.0	100.0
	Total	83	100.0	100.0	
X2.1					
Valid	Disagree	5	6.0	6.0	6.0
	Agree	64	77.1	77.1	83.1
	Strongly Agree	14	16.9	16.9	100.0
	Total	83	100.0	100.0	
X2.2					
Valid	Disagree	2	2.4	2.4	2.4
	Agree	65	78.3	78.3	80.7
	Strongly Agree	16	19.3	19.3	100.0
	Total	83	100.0	100.0	
X2.3					
Valid	Disagree	5	6.0	6.0	6.0
	Agree	67	80.7	80.7	86.7
	Strongly Agree	11	13.3	13.3	100.0
	Total	83	100.0	100.0	
X2.4					
Valid	Disagree	4	4.8	4.8	4.8
	Agree	67	80.7	80.7	85.5
	Strongly Agree	12	14.5	14.5	100.0
	Total	83	100.0	100.0	
X2.5					
Valid	Disagree	5	6.0	6.0	6.0
	Agree	68	81.9	81.9	88.0
	Strongly Agree	10	12.0	12.0	100.0
	Total	83	100.0	100.0	
X2.6					

Valid	Disagree	6	7.2	7.2	7.2
	Agree	65	78.3	78.3	85.5
	Strongly Agree	12	14.5	14.5	100.0
	Total	83	100.0	100.0	
X2.7					
Valid	Disagree	3	3.6	3.6	3.6
	Agree	69	83.1	83.1	86.7
	Strongly Agree	11	13.3	13.3	100.0
	Total	83	100.0	100.0	
X2.8					
Valid	Disagree	1	1.2	1.2	1.2
	Agree	66	79.5	79.5	80.7
	Strongly Agree	16	19.3	19.3	100.0
	Total	83	100.0	100.0	
X3.1					
Valid	Disagree	4	4.8	4.8	4.8
	Agree	65	78.3	78.3	83.1
	Strongly Agree	14	16.9	16.9	100.0
	Total	83	100.0	100.0	
X3.2					
Valid	Disagree	8	9.6	9.6	9.6
	Agree	59	71.1	71.1	80.7
	Strongly Agree	16	19.3	19.3	100.0
	Total	83	100.0	100.0	
X3.3					
Valid	Disagree	9	10.8	10.8	10.8
	Agree	60	72.3	72.3	83.1
	Strongly Agree	14	16.9	16.9	100.0
	Total	83	100.0	100.0	

X.1=Section 1 of the questionnaire, X.2=Section 2 of the questionnaire, X.3=Section 3 of the questionnaire

Using the Pearson correlation approach, the validity test was carried out in this study, and it was determined that the 19 questions in the questionnaire were valid. Meanwhile, the reliability test was carried out using the Cronbach's alpha method. Cronbach's alpha is a measure of how dependable a variable is. If the value is greater than the critical point, which is 0.7, it is determined that the variable is reliable. Based on the information in the following table, the Cronbach's alpha value was determined to be 0.963. Because the number is more than 0.7, it is possible to conclude that the data is "Highly Reliable". The result of the Cronbach' alpha is presented as follow:

Table 2. The Reliability of Questionnaire

Reliability Statistics	
Cronbach's Alpha	**N of Items**
.963	19

The study aimed to examine the use and long-term sustainability of Microsoft Teams as a digital learning platform in public junior high schools in Surabaya, East Java, Indonesia. Through a structured questionnaire, the research analyzed key dimensions of the platform's functionality, focusing on how it supports teaching and learning. The questionnaire was based on the Task-Technology Fit (TTF) paradigm, which includes three core constructs: "Task Technology Fit (TTF)," "Perceived Impacts of Microsoft Teams for Teaching and Learning," and "Expected Consequences of Using Microsoft Teams." The findings were analyzed a detailed understanding of teachers' perceptions and experiences.

Task Technology Fit (TTF) of Microsoft Teams

The findings revealed that the majority of teachers believed Microsoft Teams effectively supported their instructional tasks. On the Likert scale, most participants rated the platform with scores of 3 (Agree) or 4 (Strongly Agree), indicating high satisfaction with its ability to meet professional needs. A small number of respondents expressed dissatisfaction, reflected in ratings of 1 (Strongly Disagree) or 2 (Disagree). However, the general consensus was that Microsoft Teams

offered a robust task-technology fit, ensuring that teaching activities were well-aligned with the platform's features. Teachers highlighted the platform's ability to streamline lesson delivery, manage student activities, and support collaboration, underscoring its potential for integrating technology into traditional teaching practices.

Perceived Impacts of Microsoft Teams for Teaching and Learning

Teachers reported numerous positive impacts of Microsoft Teams on their teaching effectiveness and classroom interactions. These benefits included improved communication with students, better organization of instructional materials, and enhanced accessibility to teaching resources. The majority of participants rated the platform positively, with many noting its contribution to improved learning outcomes. While a small fraction of respondents expressed concerns about the platform's limitations, the overall feedback suggested that Microsoft Teams had a transformative effect on teaching practices. The results align with prior research that emphasizes the potential of digital platforms to enhance pedagogical efficiency and learner engagement.

The anticipated long-term consequences of using Microsoft Teams were also evaluated. Most teachers agreed that the platform could yield positive outcomes, such as improved teacher productivity, increased effectiveness in lesson delivery, and better student performance. These findings highlight Microsoft Teams' potential to serve as a sustainable tool for digital learning in junior high schools. The respondents emphasized that the platform's scalability and adaptability make it a viable solution for long-term educational strategies, provided ongoing technical support and professional training are ensured.

The study underscored the need for continuous technological support to optimize the usability and reliability of Microsoft Teams. Participants highlighted the importance of a user-friendly interface, seamless compatibility with existing educational tools, and consistent technical assistance. These factors were deemed critical in ensuring the platform's effectiveness in supporting teaching and learning. Teachers also stressed that enhancements in these areas would further solidify Microsoft Teams' role as a cornerstone of digital education. In addition to supporting teachers, Microsoft Teams demonstrated significant benefits for student engagement and interaction. Teachers observed that the platform fostered improved communication and collaboration among students, leading to enhanced participation in class activities. This finding aligns with previous studies that have shown digital platforms can create interactive and collaborative learning environments (Allison & Hudson, 2020). By promoting active participation, Microsoft Teams helps bridge the gap between traditional and digital learning modalities, enabling students to adapt to modern educational requirements.

Effectiveness of the Task-Technology Fit (TTF)

The study highlighted the strong alignment between Microsoft Teams' functionalities and the instructional tasks of teachers. Participants expressed satisfaction with the platform's ease of use, compatibility, and flexibility in supporting various teaching needs. The positive impacts included streamlined lesson delivery, enhanced teaching efficiency, and better management of student learning activities. These findings echo earlier research suggesting that platforms with a high TTF score contribute significantly to teaching success and student achievement.

The findings of this study are consistent with a growing body of literature that highlights the role of digital platforms in enhancing education. Prior studies have demonstrated that tools like Microsoft Teams can improve task performance, foster better communication, and create a more engaging learning environment. This study adds to the existing knowledge base by focusing on the specific context of junior high schools in Surabaya, offering localized insights into the platform's effectiveness.

While Microsoft Teams has proven to be a valuable educational tool, the study identified several challenges that need to be addressed. These include technical issues, limited digital literacy among some teachers, and the need for comprehensive training programs. Participants suggested that targeted professional development and investments in infrastructure could significantly enhance the platform's utility. Addressing these challenges is essential for ensuring that Microsoft Teams remains a reliable and effective solution for digital learning (Dhiyaulhaq & binti Hassan, 2023).

Implication

The findings of this study have practical implications for schools, policymakers, and educational stakeholders. By leveraging the strengths of Microsoft Teams, schools can create more efficient and engaging learning environments (Castellanos, V., & Choco, 2020). Policymakers can use these insights to develop guidelines for integrating digital platforms into educational curricula, ensuring that teachers receive the necessary support and resources. Additionally, continuous evaluation and feedback mechanisms can help refine the implementation of Microsoft Teams, making it a more effective tool for education.

This study provides valuable insights into the use of Microsoft Teams as a digital learning platform in junior high schools. Its findings highlight the platform's effectiveness in supporting teaching and learning, its positive impacts on student engagement, and its potential for long-term sustainability. By addressing the identified challenges, schools can maximize the benefits of Microsoft Teams, fostering a more adaptive and resilient education system (Buchal & Songsore, 2019). The study's contributions underscore the importance of integrating technology into education, paving the way for a future where digital learning is seamlessly embedded in the classroom experience.

CONCLUSION

This study concludes that mathematics teachers perceive Microsoft Teams as an effective and adaptable tool for supporting digital teaching practices. The platform's high task-technology fit and positive teacher perceptions highlight its potential for long-term sustainability in digital education. Teachers appreciated its usability, functionality, and flexibility, which align with the evolving needs of modern teaching environments. However, challenges such as time management and limited training opportunities were identified, indicating areas for improvement to ensure sustained usage.

These findings are based on validated and reliable data collected from 83 mathematics teachers, providing a focused understanding of the platform's role in digital education. While promising, the study's scope is limited to a specific context, and future research should expand to larger and more diverse populations. Future investigations should also explore additional perspectives, such as those of students, to provide a more holistic understanding of Microsoft Teams' impact on teaching and learning.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the conception and design of the study

Tri Achmad	:	Study design and data analysis
Rizki	:	Instrument development and validation
Wahyu	:	Literature review and manuscript drafting
Abd Syakur	:	Manuscript review and finalization

REFERENCE

Abar, C. A. A. P., De Almeida, M. V., & Lavicza, Z. (2024). Arts and mathematics: GeoGebra focused on isometric transformations. *Journal of Mathematics and the Arts*, *18*(1–2), 47–65. https://doi.org/10.1080/17513472.2024.2365361

Aguaded, I., Vizcaíno-Verdú, A., García-Prieto, V., & de-Casas-Moreno, P. (2023). The Impact of Post-Pandemic Learning Loss on Education Development: A Systematic Review. *Review of Communication Research*, *11*, 172–189. https://doi.org/10.5680/RCR.V11.7

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher education studies*, *10*(3), 16-25. https://doi.org/10.5539/hes.v10n3p16

Allison, N., & Hudson, J. (2020). *Integrating and sustaining directed and self-directed learning through MS Teams and OneNote: Using Microsoft Teams and OneNote to facilitate communication, assignments, and portfolio management*.

Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and information technologies*, *25*, 5261-5280. https://doi.org/10.1007/s10639-020-10219-y

Bsharat, T. R. K., & Behak, F. (2020). The impact of Microsoft teams' app in enhancing teaching-learning English during the Coronavirus (COVID-19) from the English teachers' perspectives' in Jenin city. *Malaysian Journal of Science, Health & Technology (MJoSHT)*. https://doi.org/10.33102/mjosht.v7io.116

Buchal, R., & Songsore, E. (2019). Using Microsoft Teams to support collaborative knowledge building in the context of sustainability assessment. *Proceedings of the Canadian Engineering Education Association (CEEA)*. https://doi.org/10.24908/pceea.vi0.13806

Cardenas, J., Castellanos, V., Gonzalez, S., & Choco, M. (2021). *Teachers Perception and Evaluation of the Success of Microsoft Teams Learning Management System at Orange Walk Technical High School*. *4 no.1*.

Casany, M. J., Alier, M., & Barceló, M. (2012). Integration of M-learning and LMS: A sustainability approach. *2012 International Symposium on Computers in Education (SIIE)*, 1–6.

Castellanos, V., & Choco, M. (2020). *Teachers Perception and Evaluation of the Success of Microsoft Teams Learning Management System at Orange Walk Technical High School*. 1–15.

Chan, R. Y., Bista, K., & Allen, R. M. (2021). Is Online and Distance Learning the Future in Global Higher Education?: The Faculty Perspectives during COVID-19. In *Online teaching and learning in higher education during COVID-19* (pp. 3–12). Routledge. https://doi.org/10.4324/9781003125921-2

De Vera, M. C., & Balgua, B.-L. O. (2023). *Utilization of technologies in teaching mathematics in a flexible learning environment*. *2602*. Scopus. https://doi.org/10.1063/5.0147566

Dhiyaulhaq, T. S. A. S. A., & binti Hassan, F. A. (2023). Acceptance on Using Microsoft Teams in Learning the English Language amongst Undergraduate Students. *Journal of English Language Teaching and Applied Linguistics*, *5*(1), 35–44. https://doi.org/10.32996/jeltal.2023.5.1.5

Finlay, M. J., Tinnion, D. J., & Simpson, T. (2022). A virtual versus blended learning approach to higher education during the COVID-19 pandemic: The experiences of a sport and exercise science student cohort. *Journal of Hospitality, Leisure, Sport & Tourism Education*, *30*, 100363. https://doi.org/10.1016/j.jhlste.2021.100363

Gauthier, N. H., & Husain, M. I. (2021). Dynamic security analysis of zoom, Google meet and Microsoft teams. *Silicon Valley Cybersecurity Conference: First Conference, SVCC 2020, San Jose, CA, USA, December 17–19, 2020, Revised Selected Papers 1*, 3–24. https://doi.org/10.1007/978-3-030-72725-3_1

Herzallah, H. T., Jerad, O. M. A., Sarah, A. M. A., & Dweikat, L. N. (2023). The Reality of Employing the Microsoft Application Teams in Learning Mathematics Remotely During the COVID-19 Pandemic in Palestine. In *Comparative Research on Diversity in Virtual Learning: Eastern vs. Western Perspectives* (pp. 62–87). IGI Global. https://doi.org/10.4018/978-1-6684-3595-3.ch004

Hettiarachchi, E., Mor, E., Huertas, M. A., & Guerrero-Roldán, A.-E. (2015). Introducing a Formative E-Assessment System to Improve Online Learning Experience and Performance. *J. Univers. Comput. Sci.*, *21*(8), 1001–1021.

Hettiarachchi, S., Damayanthi, B. W. R., Heenkenda, S., Dissanayake, D., Ranagalage, M., & Ananda, L. (2021). Student satisfaction with online learning during the COVID-19 pandemic: A study at state universities in Sri Lanka. *Sustainability*, *13*(21), 11749. https://doi.org/10.3390/su132111749

Hoi, S. C. H., Sahoo, D., Lu, J., & Zhao, P. (2021). Online learning: A comprehensive survey. *Neurocomputing*, *459*(c), 249–289. https://doi.org/10.1016/j.neucom.2021.04.112

Horzum, M. B. (2017). Interaction, structure, social presence, and satisfaction in online learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(3), 505–512. https://doi.org/10.12973/eurasia.2014.1324a

Hsia, L. H., Huang, I., & Hwang, G. J. (2016). Effects of different online peer-feedback approaches on students' performance skills, motivation and self-efficacy in a dance course. *Computers & Education*, *96*, 55-71. https://doi.org/10.1016/j.compedu.2016.02.004

Ilag, B. N., & Sabale, A. M. (2022). Microsoft teams overview. In *Troubleshooting Microsoft Teams: Enlisting the Right Approach and Tools in Teams for Mapping and Troubleshooting Issues* (pp. 17–74). Springer. https://doi.org/10.1007/978-1-4842-8622-7_2

Ismail, S., & Ismail, S. (2021). Teaching approach using microsoft teams: Case study on satisfaction versus barriers in online learning environment. *Journal of Physics: Conference Series*, *1874*(1), 12020. https://doi.org/10.1088/1742-6596/1874/1/012020

Jeljeli, R., Farhi, F., Setoutah, S., & Laghouag, A. (2022). Microsoft teams' acceptance for the e-learning purposes during Covid-19 outbreak: A case study of UAE. *International Journal of Data and Network Science*, *6*(3), 629-640. https://doi.org/10.5267/j.ijdns.2022.4.010

Jacques, S., Ouahabi, A., & Lequeu, T. (2021). *Synchronous E-learning in higher education during the COVID-19 pandemic*. *2021-April*, 1102–1109. Scopus. https://doi.org/10.1109/EDUCON46332.2021.9453887

Kansal, A. K., Gautam, J., Chintalapudi, N., Jain, S., & Battineni, G. (2021). Google trend analysis and paradigm shift of online education platforms during the COVID-19 pandemic. *Infectious Disease Reports*, *13*(2), 418–428. Scopus. https://doi.org/10.3390/idr13020040

Kemendikbud. (2020).

Khrisat, Z., & Fakhouri, H. N. (2024). Impact of E-learning Tools (Moodle, Microsoft Teams, Zoom) on Student Engagement and Achievement at Jordan Universities. *International Journal of Interactive Mobile Technologies*, *18*(18), 125–145. Scopus. https://doi.org/10.3991/ijim.v18i18.49895

Li, D. (2022). The Shift to Online Classes during the COVID-19 Pandemic: Benefits, Challenges, and Required Improvements from the Students' Perspective. *Electronic Journal of E-Learning*, *20*(1), 1-18. https://doi.org/10.34190/ejel.20.1.2106

Liu, M., & Yu, D. (2023). Towards intelligent E-learning systems. *Education and Information Technologies*, *28*(7), 7845-7876. https://doi.org/10.1007/s10639-022-11479-6

Mahyoob, M. (2021). Online learning effectiveness during the COVID-19 pandemic: A case study of Saudi universities. *International Journal of Information and Communication Technology Education (IJICTE)*, *17*(4), 1–14. https://doi.org/10.4018/IJICTE.20211001.oa7

Mesuwini, J., & Mokoena, S. (2024). Exploring Online Teaching and Learning Challenges for the Technical and Vocational Education and Training Lecturer. *Journal of Education and e-Learning Research*, *11*(1), 193-202. https://doi.org/10.20448/jeelr.v11i1.5423

Mitrović, S., Božić, R., & Takači, Đ. (2024). Efficiency of blended learning of calculus content during the Covid19 crisis. *Interactive Learning Environments*, *32*(1), 52–66. https://doi.org/10.1080/10494820.2022.2076129

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education*, *14*(2), 129–135. https://doi.org/10.1016/j.iheduc.2010.10.001

Moscoviz, L., & Evans, D. K. (2022). *Learning loss and student dropouts during the covid-19 pandemic: A review of the evidence two years after schools shut down*. Center for Global Development Washington, DC, USA.

Noushad, P. P. (2024). Aligning Learning Outcomes with Learning Process. In *Designing and Implementing the Outcome-Based Education Framework* (pp. 139-202). Springer, Singapore. https://doi.org/10.1007/978-981-96-0440-1_5

Padayachee, P., Campbell, A., & Fredericks, E. (2022). *Engaging Engineering Mathematics students online: Tutoring using MS Teams*. 2022 IEEE IFEES World Engineering Education Forum - Global Engineering Deans Council, WEEF-GEDC 2022 - Conference Proceedings. Scopus. https://doi.org/10.1109/WEEF-GEDC54384.2022.9996206

Singh, M., Patidar, V., Ayyub, S., Soni, A., Vyas, M., Sharma, D., & Ranadive, A. (2023). An Analytical Survey of Difficulty Faced in an Online Lecture During COVID-19 Pandemic Using CRISP-DM. *Journal of Computer Science*, *19*(2), 242–250. Scopus. https://doi.org/10.3844/jcssp.2023.242.250

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *American Journal of Distance Education*, *33*(4), 289–306. https://doi.org/10.1080/08923647.2019.1663082

Sobaih, A. E. E., Salem, A. E., Hasanein, A. M., & Abu Elnasr, A. E. (2021). Responses to covid-19 in higher education: Students' learning experience using microsoft teams versus social network sites. *Sustainability (Switzerland)*, *13*(18). Scopus. https://doi.org/10.3390/su131810036

Sofi-Karim, M., Bali, A. O., & Rached, K. (2023). Online education via media platforms and applications as an innovative teaching method. *Education and Information Technologies*, *28*(1), 507–523. https://doi.org/10.1007/s10639-022-11188-0

Wajdi, M. B. N., Kuswandi, I., Al Faruq, U., Zulhijra, Z., Khairudin, K., & Khoiriyah, K. (2020). Education policy overcome coronavirus, a study of Indonesians. *EDUTEC: Journal of Education And Technology*, *3*(2), 96-106. https://doi.org/10.29062/edu.v3i2.42

Wea, K. N., & Kuki, A. D. (2021). Students' perceptions of using Microsoft Teams application in online learning during the Covid-19 pandemic. *Journal of Physics: Conference Series*, *1842*(1), 12016. https://doi.org/10.1088/1742-6596/1842/1/012016

Wei, X., Saab, N., & Admiraal, W. (2021). Assessment of cognitive, behavioral, and affective learning outcomes in massive open online courses: A systematic literature review. *Computers & Education*, *163*, 104097. https://doi.org/10.1016/j.compedu.2020.104097

Welch, A., & Aziz, E. A. (2022). Higher Education in Indonesia. In *International Handbook on Education in South East Asia* (pp. 1-30). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-16-8136-3_41-1

Xu, Z., Zhao, Y., Liew, J., Zhou, X., & Kogut, A. (2023). Synthesizing research evidence on self-regulated learning and academic achievement in online and blended learning environments: A scoping review. *Educational Research Review*, *39*(December 2022), 100510. https://doi.org/10.1016/j.edurev.2023.100510