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RESEARCH ARTICLE

Challenges in Implementing the Discovery Flipped Classroom Model Assisted by Google Sites in Maths Learning

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ABSTRACT

This study aims to analyse the challenges in implementing the Discovery Flipped Classroom model assisted by Google Sites in mathematics learning in North Maluku Province. Using a descriptive quantitative approach, the study involved 250 students and 40 teachers from three senior high schools. Data were collected through a 5-point Likert scale questionnaire measuring four dimensions of challenges: technical, pedagogical, student motivation and teacher readiness. Results showed that technical issues were the biggest challenge for students (M=3.85, SD=0.724) mainly related to internet accessibility and device availability, while teachers faced the main challenge on the pedagogical aspect (M=3.78, SD=0.745) in adapting learning strategies. The student motivation dimension showed moderate challenges (M=3.24, SD=0.912), while teacher readiness showed different perceptions between students (M=2.95) and teachers (M=3.56). These findings provide important insights for the development of more effective technology-based learning implementation strategies, particularly in areas with limited infrastructure.

INTRODUCTION

The integration of technology in education has brought significant transformation in teaching and learning practices, one of which is through innovative models such as the *Discovery Flipped Classroom*. This model combines the principles of *discovery learning* with a *flipped classroom* approach, where students are given the opportunity to explore learning materials independently before engaging in face-to-face sessions with the teacher (Bergmann & Sams, 2012; Hamdan et al., 2013). This approach is believed to increase student engagement, encourage deeper learning, and facilitate the development of 21st century skills such as critical thinking and collaboration (Bishop & Verleger, 2013).

Google Sites, as a free and easily accessible platform, is increasingly used to support the implementation of the *Discovery Flipped Classroom* model. The platform allows teachers to create interactive learning websites that students can access anytime and anywhere, thus facilitating self-directed learning (Almeida & Simoes, 2019). However, despite its great potential, the implementation of this model in mathematics learning presents several challenges that require systematic investigation.

This study aims to examine the challenges of implementing the Google Sites-assisted *Discovery Flipped Classroom* model, focusing on four main barriers: technical issues, pedagogical challenges, student motivation, and teacher readiness. Technical issues often arise due to limited technological infrastructure or lack of digital literacy (Hwang et al., 2015). Pedagogical challenges include difficulties in designing learning activities that suit students' needs (Abeysekera & Dawson, 2015).

Student motivation is also a critical factor, as self-directed learning requires high discipline and independence (Chen et al., 2014). In addition, teachers' readiness to integrate technology and implement new approaches is also a significant challenge (Ertmer et al., 2012).

By identifying and understanding these barriers, educators can develop targeted strategies to optimise the effectiveness of the *Discovery Flipped Classroom* model assisted by Google Sites. This research is expected to make a practical contribution to the professional development of teachers as well as improving the quality of mathematics learning in the digital era.

LITERATURE REVIEW

Discovery Flipped Classroom in Maths Learning

The *Discovery Flipped Classroom* model combines the principles of *discovery learning* (Bruner, 1961) with the *flipped classroom* approach (Bergmann & Sams, 2012). In mathematics learning, this model facilitates students to explore mathematical concepts independently through pre-class materials (videos, simulations, or digital modules) before face-to-face sessions. This exploration phase allows students to build conceptual understanding, which is then deepened through collaborative discussions and the application of problem-solving strategies in class (Bishop & Verleger, 2013; Lo & Hew, 2017).

Research shows that this approach is effective in increasing student engagement and knowledge retention in STEM subjects, including maths. For example, the study by Bhagat et al. (2016) found that students in a *flipped* maths classroom experienced significant improvements in understanding algebra and geometry concepts. This is supported by the model's ability to accommodate diverse learning needs, such as the use of multimedia content for visual students and the flexibility of self-study time (Tucker, 2023). However, the main challenge lies in the design of pre-class materials that must avoid conceptual errors and provide *scaffolding* for low-ability students (Clark, 1982; Hwang et al., 2015).

The Role of Google Sites in Digital Learning

Google Sites is a web-based platform that allows teachers to centrally organise learning content, assignments, and interactive resources (Almeida & Simoes, 2019). Its integration with Google Workspace tools (Drive, Forms, YouTube) enables dynamic presentation of materials, such as video tutorials, automated quizzes, and discussion forums, thereby increasing accessibility and student participation (Cheng, 2020).

In the context of the *Discovery Flipped Classroom*, Google Sites acts as a "gateway" to self-paced learning. For example, teachers can construct maths exploration modules with links to interactive geometry simulations or statistical case studies (Hapsari, 2021). However, the effectiveness of this platform depends on the digital competence of teachers and students. Research by Hsu et al. (2019) revealed that limited digital literacy often hinders the utilisation of complex features, such as HTML code embedding or learning analytics. Therefore, technical training and institutional support are needed to maximise the potential of these platforms (Ertmer et al., 2012).

Challenges in Technology Assisted Learning

The implementation of technology-assisted learning, including the Google Sites-based *Discovery Flipped Classroom* model, faces three main challenges. Firstly, infrastructure limitations such as uneven internet access and availability of adequate devices are still an obstacle in many regions, especially in rural areas (OECD, 2020). This creates a digital divide that hinders equitable access to learning. Secondly, inadequate digital literacy in teachers and students is often a barrier. For example,

teachers may struggle to design technology-based interactive content, while students lack the ability to effectively manage self-study time (Van Laar et al., 2020). Thirdly, resistance to pedagogical change often arises due to discomfort in leaving established traditional methods. The shift to technology-based approaches is often resisted by those who are reluctant to adapt to new habits (Zhao & Frank, 2003). To overcome this challenge, Ertmer (1999) emphasises the importance of a combined *top-down* (through supportive institutional policies) and *bottom-up* (through teacher training to improve technical competence) approach. In addition, Hew and Brush's (2007) study recommends inter-school collaboration to share resources, learning tools and best practices, thus creating a sustainable support ecosystem. With these strategies, barriers to implementation can be minimised, enabling more inclusive and effective use of educational technology.

RESEARCH METHODOLOGY

Research Design

This study used a descriptive quantitative approach to analyse the challenges of implementing the Discovery Flipped Classroom model aided by Google Sites. This design was chosen as it allows for the systematic identification of barriers through the collection of numerical data that can be measured and categorised (Lo & Hew, 2017). Data were collected using a structured questionnaire with a 5-point Likert scale, designed to evaluate four dimensions of challenges: technical, pedagogical, student motivation, and teacher preparedness. The study population included mathematics teachers and high school students in North Maluku Province, with a stratified random sampling technique to ensure diverse representation from the three selected schools. Descriptive statistical analyses, such as percentage calculations, mean scores and standard deviations, were applied to interpret the data, in accordance with methodological recommendations in educational technology-based research (Ertmer et al., 2012). This approach aimed to provide a comprehensive picture of implementation challenges, while supporting evidence-based decision-making for educators and policy makers.

Population and Sample

The study was conducted in North Maluku Province, involving mathematics teachers and students from three secondary schools: SMA Negeri 4 East Halmahera, SMA Negeri 3 North Halmahera, and SMA Negeri 12 South Halmahera. A stratified random sampling technique was used to ensure diverse representation. The sample consisted of 250 students and 40 teachers, proportionally distributed across the three schools.

Data Collection Instruments

This study used a structured questionnaire based on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) to measure the challenges of implementing the *Discovery Flipped Classroom* model. The questionnaire was designed based on four main dimensions adapted from previous research frameworks: (1) technical issues (internet access, device availability, and digital literacy), (2) pedagogical challenges (instructional design effectiveness and method adaptation), (3) student motivation (engagement and learning independence), and (4) teacher readiness (technological competence and pedagogical adaptation) (Ertmer et al., 2012; Abeysekera & Dawson, 2015). The validity of the instrument was tested through *expert judgement* by two educational technologists, while reliability was measured using Cronbach's Alpha coefficient ($\alpha = 0.87$), which indicates high internal consistency (Fraenkel et al., 2012). The questionnaire questions were designed to ensure suitability to the context of Google Sites-assisted mathematics learning, referring to previous studies on the integration of digital platforms in *flipped classrooms* (Bishop & Verleger, 2013; Hwang et al., 2015). This process ensured the instrument was able to collect accurate and relevant data for a holistic analysis of implementation challenges.

DATA ANALYSIS

The collected data were analysed using descriptive statistical techniques to identify the pattern and distribution of challenges in implementing the *Discovery Flipped Classroom* model. *Mean* scores, standard deviations and percentage distributions were calculated for each category of challenges (technical, pedagogical, motivational and teacher readiness) to provide a comprehensive quantitative picture (Creswell, 2014). This analysis was chosen for its ability to present data in a measurable and easily interpretable form, particularly in the context of exploratory research (Hair et al., 2019).

RESULTS AND DISCUSSION

Data Distribution and Analysis

Before conducting the main analysis, the research instruments were tested for validity and reliability. The validity test was conducted using Pearson's Product Moment correlation with a significance level of 5%. The validity test results show that all question items have an r-count value > r-table (0.304), with a value range of 0.512 to 0.847, indicating that all items are valid.

The reliability test using Alpha Cronbach resulted in the following coefficient values:

- Technical Issues dimension: $\alpha = 0.892$
- Pedagogical Challenge Dimension: $\alpha = 0.875$
- Student Motivation dimension: $\alpha = 0.883$
- Teacher Readiness Dimension: $\alpha = 0.864$

Cronbach's Alpha values > 0.8 for all dimensions indicate high reliability of the research instruments.

Data collected from 250 students and 40 teachers revealed important insights into the challenges of implementing the Google Sites-assisted Discovery Flipped Classroom model. The findings were categorised in four main areas: technical issues, pedagogical challenges, student motivation, and teacher preparedness. Descriptive analyses for each dimension follow:

Table 1. Descriptive Statistics of Implementation Challenges

Dimensions	Mean (Students)	Standard Deviation (Student)	Mean (Teacher)	Standard Deviation (Teacher)
Technical Issues	3.85	0.724	3.45	0.682
Pedagogical Challenges	3.62	0.856	3.78	0.745
Student Motivation	3.24	0.912	3.32	0.824
Teacher Readiness	2.95	0.878	3.56	0.796

Table. 2 Percentage distribution of

Challenge	Students (%)	Teacher (%)
Technical Issues	35%	25%
Pedagogical Challenges	30%	35%
Student Motivation	20%	20%
Teacher Readiness	15%	20%

Technical Challenges

The analysis showed that technical issues were the most significant challenge for students, with a mean score of 3.85 (SD = 0.724), while teachers reported a lower mean of 3.45 (SD = 0.682). Around 35 per cent of students reported experiencing technical barriers, mainly related to internet accessibility and device availability. The relatively small standard deviation indicates the consistency of respondents' perceptions of these technical challenges.

In North Maluku Province, infrastructure limitations exacerbate this problem, as many students do not have reliable internet connections or access to personal devices. For teachers (25 per cent), technical challenges mainly relate to the ability to operate Google Sites and its integration with other Google tools.

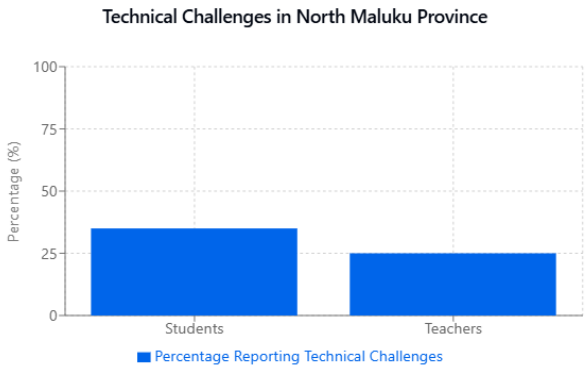

Figure 1: Technical challenge graph

Pedagogical Challenges

Data analysis showed high mean pedagogical challenge scores from both students (M = 3.62, SD = 0.856) and teachers (M = 3.78, SD = 0.745). The percentage of this challenge reached 30% for students and 35% for teachers. The higher standard deviation in students' responses indicates greater variation in their perceptions of pedagogical challenges.

Teachers expressed difficulty in adapting their instructional strategies to the flipped classroom model, especially in designing pre-class activities. Teachers' high mean scores indicate that this is an area that needs special attention in professional development.

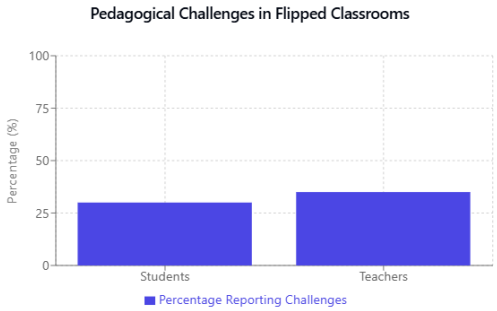

Figure 1: Graph of Pedagogical Challenges

Student Motivation

The student motivation dimension showed moderate mean scores from both student (M = 3.24, SD = 0.912) and teacher (M = 3.32, SD = 0.824) perspectives. The percentage reporting motivational challenges reached 20 per cent of both groups of respondents. The relatively high standard deviation indicates significant variation in students' motivational learning experiences.

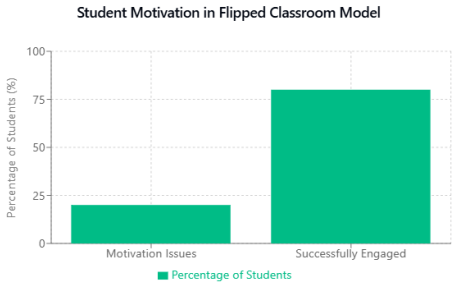

Figure 1: Motivation Graph

Teacher Readiness

Analyses of teacher readiness showed interesting perceptual differences between students (M = 2.95, SD = 0.878) and teachers themselves (M = 3.56, SD = 0.796). About 20% of teachers reported challenges in their readiness to integrate technology. The higher mean score from the teachers' perspective indicates their awareness of the challenges in adopting this new learning approach.

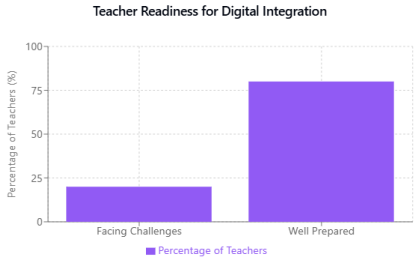

Figure 1: Teacher readiness graph

CONCLUSIONS

This study identified and analysed four main challenges in implementing the Discovery Flipped Classroom model assisted by Google Sites in mathematics learning in North Maluku Province. Based

on data analysis from 250 students and 40 teachers, it was found that technical issues were the most significant challenge for students (M=3.85, SD=0.724), especially related to limited internet access and device availability. Meanwhile, teachers faced major challenges in the pedagogical aspect (M=3.78, SD=0.745), particularly in adapting conventional learning strategies to the flipped classroom model. The student motivation dimension showed moderate challenges (M=3.24, SD=0.912), indicating the need for special strategies to maintain student engagement in self-directed learning. The teacher readiness aspect shows an interesting difference in perception between students (M=2.95) and teachers (M=3.56), indicating a gap between students' expectations and teachers' self-assessment of readiness to integrate technology in learning.

Addressing these challenges requires a comprehensive multi-faceted approach that includes improving technology infrastructure and internet access in schools, continuous professional development programmes to improve teachers' digital literacy and pedagogical competence, structured mentoring systems to support students' learning independence, and the development of locally appropriate digital learning content.

Recommendations for Further Research

Based on the findings of this study, several further research directions need to be developed to deepen the understanding and solutions to the challenges. First, longitudinal studies are needed to observe changes in implementation challenges over time, analyse the effectiveness of various intervention strategies, and evaluate the impact of professional development programs on improving teacher competencies. The development of intervention models is also an important focus, including the design of mentoring-based teacher assistance systems, the development of learning content adaptation frameworks for contexts with limited infrastructure, and the design of sustainable technical support systems.

Contextual analyses need to be conducted through comparative studies in different regions with different characteristics, identifying socio-cultural factors that influence successful implementation and examining the role of school leadership in supporting digital transformation. The development of more comprehensive evaluation instruments is also needed, including school readiness measurement tools, learning effectiveness evaluation rubrics, and assessment frameworks to measure the impact on student learning outcomes.

Impact studies need to be conducted to examine the relationship between model implementation and improved academic performance, analyse the impact on 21st century skills development, and examine the social-emotional impact on students and teachers. Optimisation of the Google Sites platform is also an important area of research, including the exploration of advanced features, the effectiveness of different digital content formats, and the development of best practice guidelines for learning content design.

Policy and sustainability aspects need to be further explored through research on the effectiveness of various policy models, sustainable financing strategies for school digitalisation programs, and analysis of the role of multi-stakeholder collaboration in supporting the digital transformation of education. These studies are expected to provide a deeper understanding of the implementation of technology-based learning and produce practical solutions that can be applied in various educational contexts. Thus, the challenges identified in this research can be addressed systematically and sustainably, supporting the creation of a more effective and inclusive digital learning ecosystem in the future.

REFERENCES

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: Definition, rationale and a call for research. *Higher Education Research & Development*, *34*(1), 1–14. https://doi.org/10.1080/07294360.2014.934336

Almeida, F., & Simoes, A. (2019). The role of Google Sites in blended learning. *Journal of Educational Technology Systems*, *48*(2), 183–202. https://doi.org/10.1177/0047239519875947

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education.

Bhagat, K. K., Chang, C. N., & Chang, C. Y. (2016). The impact of the flipped classroom on mathematics concept learning in high school. *Educational Technology & Society*, *19*(3), 134–142.

Bishop, J. L., & Verleger, M. A. (2013, June). The flipped classroom: A survey of the research. In *2013 ASEE Annual Conference & Exposition* (pp. 23–1200). https://doi.org/10.18260/1-2--22585

Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, *31*(1), 21–32.

Chen, Y., Wang, Y., & Chen, N. S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education*, *79*, 16–27. https://doi.org/10.1016/j.compedu.2014.07.004

Cheng, L. (2020). Google Sites as a collaborative learning tool in higher education. *Journal of Interactive Media in Education*, *2020*(1), 1–10. https://doi.org/10.5334/jime.571

Clark, R. E. (1982). Antagonism between achievement and enjoyment in ATI studies. *Educational Psychologist*, *17*(2), 92–101. https://doi.org/10.1080/00461528209529247

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47–61. https://doi.org/10.1007/BF02299597

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, *59*(2), 423–435. https://doi.org/10.1016/j.compedu.2012.02.001

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed.). McGraw-Hill.

Hamdan, N., McKnight, P., McKnight, K., & Arfstrom, K. M. (2013). *A review of flipped learning*. Flipped Learning Network.

Hapsari, A. S. (2021). Utilizing Google Sites for mathematics flipped classroom: A case study in Indonesian high schools. *Journal of Educational Technology in Higher Education*, *18*(1), 1–15. https://doi.org/10.1186/s41239-021-00260-3

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223–252. https://doi.org/10.1007/s11423-006-9022-5

Hsu, Y. C., Rice, K., & Dawley, L. (2019). Empowering educators with Google's Android app inventor: An online workshop in mobile app design. *British Journal of Educational Technology*, *50*(1), 365–378. https://doi.org/10.1111/bjet.12547

Hwang, G. J., Lai, C. L., & Wang, S. Y. (2015). Seamless flipped learning: A mobile technology-enhanced flipped classroom with effective learning strategies. *Journal of Computers in Education*, *2*(4), 449–473. https://doi.org/10.1007/s40692-015-0043-0

Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning*, *12*(1), 1–22. https://doi.org/10.1186/s41039-016-0044-2

OECD. (2020). *Education at a glance 2020: OECD indicators*. OECD Publishing. https://doi.org/10.1787/69096873-en

Tucker, B. (2023). The flipped classroom: Online instruction at home frees class time for learning. *Education Next*, *12*(1), 82–83.

Van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open*, *10*(1), 1–14. https://doi.org/10.1177/2158244019900176

Zhao, Y., & Frank, K. A. (2003). Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal*, *40*(4), 807–840. https://doi.org/10.3102/00028312040004807