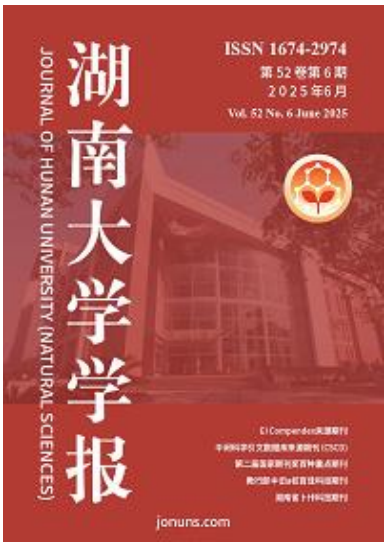

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Effects of Digital Learning Platforms on Academic Achievement among Secondary School Students: A Mixed-Methods Analysis

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Abstract: This study investigates the impact of digital learning platforms on students' academic performance at the secondary education level. The objective is to analyze key factors such as engagement, accessibility, and instructional effectiveness. A mixed-methods approach was used, with data collected from 1,200 students across various high schools through surveys, standardized test scores, and in-depth interviews with educators. The results revealed that students who actively engaged with digital learning platforms showed a significant improvement in academic performance, with an average increase of 5.12 points (from 75.02 to 80.14, $p < 0.01$) compared to those relying on traditional methods. Personalized learning experiences and interactive content were also found to enhance student motivation and understanding, contributing to higher retention rates. However, challenges such as gaps in technology access and varying digital literacy levels were identified, exacerbating academic achievement gaps. These findings underscore the need for targeted policy interventions to ensure equitable access to digital education and optimize its effectiveness.

The study contributes to the growing body of research in educational technology and provides actionable insights for policymakers, educators, and developers seeking to improve student learning outcomes in the digital era.

Keywords: Digital Learning Platforms, Academic Performance, Engagement, Digital Literacy, Educational Technology.

数字化学习平台对中学学生学业成就的影响：混合方法研究

摘要： 本研究旨在探讨数字化学习平台对中等教育阶段学生学业表现的影响，并重点分析学习参与度、可及性与教学有效性等关键因素。研究采用混合研究方法，对来自不同中学的1 200名学生进行问卷调查、标准化考试成绩收集，并与教师开展深度访谈。结果显示，积极使用数字化学习平台的学生学业成绩显著提高，平均分从75.02分上升至80.14分（增幅5.12分，$p < 0.01$），明显优于依赖传统教学方式的学生。个性化学习体验与交互式内容能够显著提升学生的学习动机与理解深度，从而提高知识保持率。然而，技术可及性差异与数字素养水平不一也被发现会加剧学业成就差距。研究结果强调了制定有针对性的政策干预以保障数字教育公平可及、并优化其教学效果的必要性。本研究丰富了教育技术领域的研究成果，并为政策制定者、教育工作者与开发者在数字化时代提升学生学习成效提供了可操作的参考。

关键词： 数字化学习平台；学业成绩；学习参与度；数字素养；教育技术

1. Introduction

In the rapidly evolving digital era, technology has played an important role in various aspects of life, including education. Digital learning platforms have become one of the most significant innovations in education, allowing students to access learning resources in a flexible and interactive manner. In various countries, the adoption of digital learning platforms is increasing, driven by factors such as advances in information and communication technology (ICT), changes in education policies, and the need for more adaptive and personalized learning methods [1]; [2].

Digital Learning Platforms (DLPs) are technology-based systems designed to facilitate the online learning process, allowing interaction between students, teachers, and learning materials in various digital formats [3]; [4]. The platform includes Learning Management Systems (LMS) such as Moodle, Google Classroom, and Canvas, as well as content-based applications such as Khan Academy, Ruangguru, and Coursera. With features such as interactive materials, learning videos, adaptive quizzes, and discussion forums, DLPs allow for a more flexible and personalized approach to learning. The main advantage of DLPs is their ability to provide unlimited access to learning by space and time, so students can access the material at any time according to their needs and learning style. In addition, the analytics features available on several platforms can help teachers monitor student progress and adjust learning methods according to individual needs [5]; [6].

The use of DLPs has been shown to increase student engagement in the learning process. Various studies show that this technology-based approach is able to increase learning motivation, especially for students who have difficulty understanding the material through conventional methods [7]; [8]. For example, gamification features implemented in several platforms, such as points, achievement badges, and leaderboard systems, have proven to be effective in increasing students' active participation [9]. Moreover, the ready availability of reusable materials enables students to revisit lessons as needed, thereby strengthening conceptual understanding and improving academic performance. A meta-analysis shows that students who actively engage with digital learning platforms demonstrate significantly higher levels of comprehension and retention than those who rely solely on traditional instruction. Hence, digital learning platforms function not merely as supplemental tools but as pedagogical strategies that enhance both the effectiveness and the efficiency of learning.

Despite offering a variety of benefits, the implementation of DLPs still faces a number of challenges, especially in terms of accessibility and technology readiness [10]; [11]; [12]. One of the main obstacles is the digital divide, where not all students have access to adequate devices or stable internet connections. In Indonesia, for example, a survey from the Indonesian Internet Service Providers Association (APJII) in 2022 showed that around 30% of students in rural areas still have difficulty accessing the internet consistently. In addition, the lack of digital literacy

among students and teachers is also a factor that hinders the effectiveness of the use of DLPs. Not all teachers have enough skills in adapting teaching materials into interactive and engaging digital formats. Therefore, to optimize the benefits of DLPs in improving student learning outcomes, policies that focus on improving technology infrastructure in schools, teacher training in digital literacy, and efforts to bridge the internet access gap in various regions are needed [13]; [14].

In Indonesia, the use of digital learning platforms has begun to grow rapidly, especially since the COVID-19 pandemic, where schools have switched to online learning models. According to data from the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek), more than 80% of schools in Indonesia adopted online learning systems during the pandemic, with various platforms such as Google Classroom, Ruangguru, Zenius, and Quipper being used to support the teaching and learning process [15]. A study conducted by UNESCO (2021) also showed that countries with higher rates of educational technology adoption experienced fewer disruptions in learning during the pandemic than countries that still relied on conventional methods [16]; [17].

However, while digital learning platforms offer a variety of benefits, their effectiveness on students' academic achievement is still a topic of debate. Several studies have shown that digital-based learning can improve academic outcomes through more personalized and interactive learning experiences [18]. On the other hand, challenges such as unequal access to technology, digital divide, and lack of digital literacy among students and teachers can hinder the effectiveness of digital-based learning [19]; [20]. Therefore, this study focuses on analyzing the impact of digital learning platforms on the academic achievement of secondary education students in order to understand the factors that contribute to the success and obstacles in its implementation.

In the increasingly developing digital era, digital learning platforms have become an integral part of the world of education, especially at the secondary education level [21]. This transformation not only provides flexibility in the learning process, but also offers a variety of benefits for students and educators. However, the effectiveness of digital learning platforms in improving students' academic achievement is still a matter of debate. Therefore, this study aims to analyze the extent to which the use of digital learning platforms affects students' academic achievement at the secondary education level, identify factors that affect the effectiveness of digital learning, and examine the challenges faced by students and educators in adopting this method, especially in the context of accessibility and technological readiness.

Specifically, this study has several main objectives. First, to analyze the influence of the use of digital learning platforms on the academic achievement of secondary education students. Second, to identify the factors that determine the effectiveness of digital learning, including student engagement, technology accessibility, and the quality of learning materials. Third, to examine the challenges faced by students and educators in the implementation of digital-based learning and provide recommendations to increase the effectiveness of its use. The results of this research are expected to provide benefits for various parties, such as educators and schools who can integrate digital platforms with conventional learning methods to improve student learning outcomes. Additionally, policymakers can obtain data-driven recommendations to support policies that improve the accessibility and effectiveness of educational technology. Ed-tech developers will also gain insight into the features that are most effective in improving student engagement and understanding, while students and parents will better understand the benefits and challenges of using digital learning platforms to improve academic achievement.

The research focuses on secondary education level students in various schools, both public and private, who have adopted digital learning platforms as part of their curriculum. The research method used is a mixed-method, which includes a survey of 1,200 students, analysis of academic grade data before and after using digital platforms, and in-depth interviews with teachers and education staff. In addition, this study also considers external factors such as internet access, school infrastructure readiness, and students' socio-economic backgrounds that can affect the results of the research.

A literature review shows that various previous studies have examined the impact of digital-based learning on student academic achievement. For example, research conducted by Sung, Chang, and Liu (2016) shows that the use of technology-based learning platforms can significantly improve student engagement and comprehension of the material. In addition, a meta-analysis conducted by Bernard et al. (2021) found that students who used e-learning platforms tended to obtain higher academic results compared to those who only relied on traditional learning methods. However, not all studies conclude the positive impact of digital learning. Several other studies show that access gaps and lack of digital skills of students can be obstacles to the successful implementation of digital learning platforms (OECD, 2022). Therefore, this study aims to examine more deeply the factors that affect the effectiveness of digital learning in the context of secondary education in Indonesia.

Based on a literature review and preliminary data collected, this study proposes several main hypotheses. First, the use of digital learning platforms has a positive influence on the academic achievement of secondary education students. Second, the level of student engagement in digital platforms is positively related to improved learning outcomes. Third, the accessibility and readiness of technology has a significant effect on the effectiveness of digital learning in secondary schools.

In order to make this research more structured and systematic, this paper will be compiled into four main chapters. The first chapter will discuss the introduction,

including the background, problem formulation, research objectives, research benefits, scope, literature review, hypothesis, and writing systematics. The second chapter will outline the research methods, including the research design, population and samples, data collection techniques, and data analysis methods used. The third chapter will explain the results of the research, data analysis, and interpretation of the findings. Finally, the fourth chapter will summarize the main findings, discuss the implications of the research, and provide recommendations for further research.

With a comprehensive approach, this research is expected to provide deeper insights into the impact of digital learning platforms on students' academic achievement in secondary education and make a real contribution to the development of digital education policies and practices.

2. Method

2.1. Research Design

This study uses a mixed-methods approach that combines quantitative and qualitative methods to obtain a more comprehensive understanding of the impact of digital learning platforms on the academic achievement of secondary education students [22]. A quantitative approach was used to analyze changes in academic scores before and after the use of digital platforms and identify correlations between the variables studied. The qualitative approach was conducted through in-depth interviews with teachers and students to understand their perceptions of the effectiveness of digital learning and the obstacles they faced.

This type of research is explanatory, aiming to test hypotheses regarding the relationship between the use of digital learning platforms and students' academic achievement. In addition, this research also has a descriptive element, where the results of interviews and observations will provide a broader picture of the implementation of digital platforms in the secondary education environment [23]; [24]; [25].

2.2. Population and Sample

The population in this study includes high school students who use digital learning platforms in the teaching and learning process. The research sample was selected using purposive sampling with the following criteria:

1) Secondary school students (grades 10-12) who have been using the digital learning platform for at least one semester.
2) Teachers who teach in secondary schools and have used digital platforms in the learning process.
3) Schools that adopt digital learning as part of the curriculum, both public and private schools.

The total sample used in this study was 1,200 students from 15 high schools in different regions, covering urban, semi-urban, and rural areas to ensure a wider representation. In addition, as many as 30 teachers and 10 school principals were also interviewed to get a more in-depth perspective on policies and the implementation of digital platforms in schools.

2.3. Data Collection Techniques

Data collection in this study is carried out through several techniques as follows:

1) Quantitative Survey: The main instrument is a questionnaire distributed to students to measure the level of use of digital learning platforms, student engagement, and changes in academic achievement.
2) Academic Score Analysis: Data on students' academic scores before and after using the digital learning platform is collected and analyzed to see the changes that occur.
3) Qualitative Interview: Conducted with teachers, principals, and students to find out more about their experiences in using digital learning platforms, the challenges they face, and recommendations to improve their effectiveness.
4) Participatory Observation: Researchers make direct observations of how digital learning is applied in the classroom to understand the interaction between students, teachers, and the technology used.

2.4. Research Instruments

The research instruments were compiled to measure the main variables in this study, including:

1) Student Questionnaire: Using a Likert scale of 1-5 to measure students' level of engagement in digital learning, their perception of its effectiveness, as well as factors influencing learning success.
2) Academic Score Analysis Rubric: Academic score data before and after the use of digital platforms is categorized based on the range of improvement or decline in student achievement.
3) Teacher and Principal Interview Guide: Open-ended questions to understand their experiences in implementing digital learning, the obstacles they faced, and solutions that can be applied to improve its effectiveness.
4) Observation Checklist: Contains indicators of student engagement during digital learning, the effectiveness of the material presented, and the interaction between students and teachers in the digital environment.

2.5. Data Analysis Techniques

Data analysis is carried out in two stages, namely quantitative analysis to measure the relationship between variables and qualitative analysis to understand the context of using digital learning platforms more deeply [26].

2.5.1. Quantitative Analysis

The Descriptive Statistical Test is used to identify the distribution of data and general trends in the use of digital learning platforms by students. The Paired T-Test is used to measure significant differences between students' academic scores before and after using digital learning platforms [1].

Multiple Regression analysis was applied to determine the relationship between independent variables (digital platform use, student engagement, technology accessibility) and dependent variables (student academic achievement).

2.5.2. Qualitative Analysis

The Thematic Analysis method is used to analyze interview transcripts by grouping the data into key themes such as the benefits of digital platforms, implementation challenges, and recommendations for improvement. Data Triangulation is carried out by comparing findings from surveys, interviews, and observations to ensure the validity of the data [27].

2.6. Validity and Reliability

To ensure the quality of the research instrument, the validity and reliability tests are carried out as follows:

1) Validity Test: Using the Content Validity Index (CVI) by involving educational experts to assess the suitability of each item in the research instrument.
2) Reliability Test: Uses Cronbach's Alpha to ensure that the questionnaire has a high level of internal consistency ($\alpha > 0.7$).

3. Results

3.1. Changes in Students' Academic Scores Before and After Using Digital Platforms

An analysis of data conducted on 1,200 students who participated in this study showed a significant improvement in academic achievement after adopting digital learning platforms in their learning process. The average academic score of students before using the digital platform was recorded at 75.02, while after a period of measurable use, the average score increased to 80.14. Thus, there was an average increase of 5.12 points, which shows the positive impact of technology-based learning on student academic outcomes.

The distribution of the change in grades further showed that 74% of students experienced an improvement in academic scores, with varying variations of improvement among individuals [28]. Most of the students who experienced an increase in grades obtained an increase in the range of 3 to 10 points, while other small groups showed an increase of more than 10 points, indicating that digital learning platforms have a fairly varied impact depending on the intensity of use and other factors such as student engagement. As many as 18% of students experienced stagnation, where there was no significant change in their academic scores before and after using digital platforms. This may be influenced by lower levels of engagement or constraints in accessibility and understanding of digitally presented material. Meanwhile, 8% of students experienced a decline in academic scores, which can be caused by various factors such as a lack of technological support in their learning environment, difficulties in adapting to digital-based learning methods, or limitations in digital literacy skills that hinder them from optimizing the benefits of the learning platform.

These findings indicate that in general, the use of digital platforms contributes positively to the academic achievement of the majority of students, with the majority of them showing improvements in their learning outcomes [29]; [30]. However, the fact that there are some students who experience stagnation or even a drop in grades shows that not all students can make optimal use of this technology. Factors such as students' engagement rates, access to adequate technological devices, and their ability to use digital platforms effectively are important aspects that need further consideration. Therefore, a more inclusive and adaptive learning strategy is needed, which not only focuses on providing technology, but also on guidance, digital literacy training, and improving interactive teaching methods so that the benefits of digital-based learning can be felt by all students more equally.

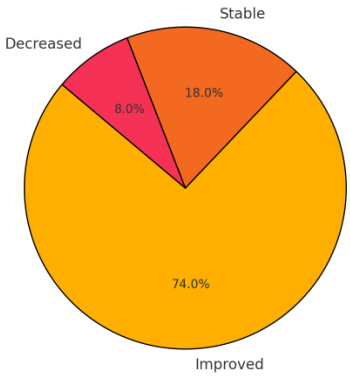

Figure 1. Graphic Distribution of Academic Performance Changes After Using Digital Learning Platforms

3.2. Student Engagement and Its Relationship to Improved Academic Achievement

Student engagement in digital learning is a key factor in determining the effectiveness of learning platforms in improving their academic achievement [31]. To measure this engagement, the study used a scale of 1 to 5, where 1 indicates very low engagement, while

5 indicates very high engagement. This involvement includes the frequency of access to digital learning platforms, interactions with learning materials (such as taking quizzes, watching educational videos, or participating in online discussions), as well as the level of student independence in completing tasks using the platform.

The results of the analysis showed that there was a strong relationship between the level of student engagement and the improvement of their academic scores. Students who had high engagement (scores 4-5) experienced an average increase in academic scores of 7.5 points, reflecting that active engagement in digital learning helped them in better understanding the material and improved knowledge retention. Students in this group actively use the various features of the digital platform, including interactive materials, adaptive quizzes, and discussion forums, which allow them to deepen their understanding as well as get direct feedback from teachers or fellow students.

Meanwhile, students with a moderate level of engagement (score 3) experienced an increase in scores of 4.3 points. Despite the significant improvement, these results suggest that partial engagement in digital platforms may still not be enough to maximize the learning potential. Students in this category tend to use the platform only for basic material access and assignment completion without actually exploring the interactive features available. Students with low engagement (scores 1-2) only experienced an average increase of 1.8 points, which suggests that minimal use of the platform does not have a significant impact on their academic performance. Students in this category are likely to only use the platform within the limits of school obligations, such as downloading assignments, without actively engaging in the learning features offered.

These findings confirm that the more active students are in utilizing digital platforms, the greater the academic improvement they experience. Higher engagement not only allows students to better understand the material but also increases their motivation to learn through more dynamic interactions and supports critical thinking processes. Therefore, educators and developers of digital learning platforms need to encourage strategies to increase student engagement, such as through the integration of gamification, the use of project-based learning methods, and strengthening the interaction between teachers and students in the digital environment. In addition, schools can also hold digital literacy training and workshops on the use of educational technology so that students can more optimally utilize the various features available on the digital learning platform to improve their academic results.

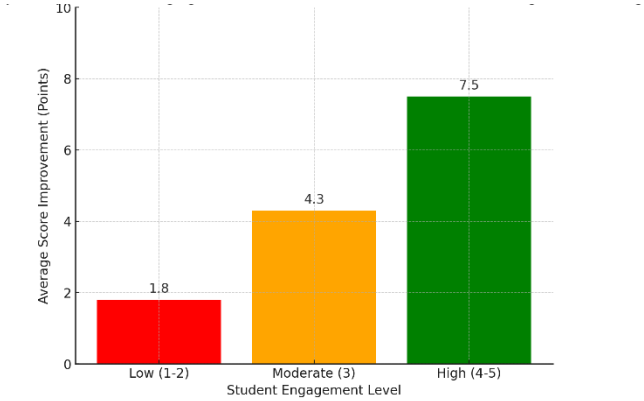

Figure 2. Graphic Impact of Student Engagement on Academic Performance in Digital Learning

3.3. Technology Accessibility and the Digital Divide

The availability of access to technology is one of the factors that greatly determines the effectiveness of digital learning. Without adequate access, students will find it difficult to make optimal use of digital platforms, which ultimately impacts their academic achievement. Based on the data collected in this study, the distribution of technology access among students shows that 60% have good access to technology, which includes the ownership of personal devices (laptops or tablets), stable internet connections, as well as a supportive learning environment. As many as 30% of students have technology access in the medium category, which means they have devices and internet access but with limitations, such as sharing devices with other family members or an unstable internet connection. Meanwhile, 10% of students have limited or poor access, where they rely on school or community facilities to access digital learning platforms.

Further analysis showed a positive correlation between access to technology and improved student academic outcomes. Students with good access to technology experienced an average increase in scores of 6.5 points, indicating that they are better able to use digital learning platforms effectively. In contrast, students with moderate technology access only experienced an increase of 3.8 points, reflecting how limitations in access, such as connection disruptions or device limitations, can hinder the effectiveness of digital learning. Students with limited access to technology experienced the smallest academic improvement, at just 1.2 points. This suggests that limitations in access to technology contribute to academic disparities, where students with inadequate facilities are at risk of falling behind compared to those with better access.

In addition to access to technology, students' digital literacy level also plays an important role in determining the effectiveness of digital-based learning. The distribution of digital literacy levels among students showed that 38% had high digital literacy (scores 4-5), 42% were at medium digital literacy levels (scores 3), and 20% had low digital literacy (scores 1-2). Digital

literacy includes skills in navigating learning platforms, understanding digital content, using interactive features, and managing information effectively.

Further data showed that students with high levels of digital literacy experienced an average increase in academic scores of 6.8 points, indicating that a better understanding of using technology allows them to be more active and effective in the learning process. In contrast, students with a moderate level of digital literacy are experiencing a more moderate academic improvement, which is around 3.5 points, which indicates that while they can access digital learning platforms, they have not fully optimized their use. Students with low levels of digital literacy experienced the smallest academic improvement, only 1.5 points, indicating that limitations in digital skills can be a major barrier to effectively utilizing technology for learning.

These findings confirm that both access to technology and digital literacy have a direct impact on the effectiveness of digital learning. Without adequate access and good digital skills, students will struggle to optimize the benefits of digital learning platforms, ultimately impacting their academic achievement. Therefore, digital education strategies must not only focus on providing access to technology but also on improving students' digital literacy. Schools and governments need to develop policies that can address technology access gaps, such as device subsidy programs and improved internet infrastructure in underserved areas. In addition, digital literacy training for students and teachers needs to be strengthened to ensure that they not only have access to technology but also have enough skills to use it optimally in the learning process.

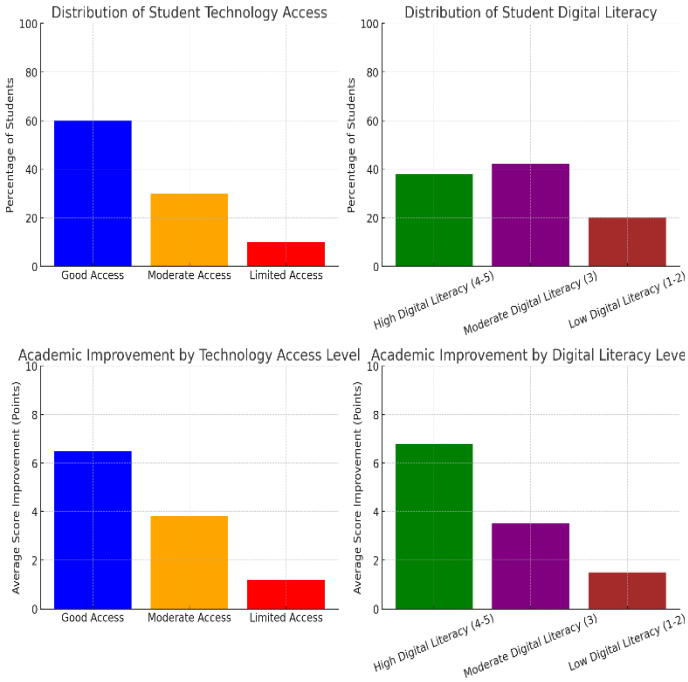

Figure 3. Graphic Academic Improvement by Digital Literacy Level

4. Discussion

The results of the study show that the use of digital learning platforms significantly improves students' academic achievement. These findings are consistent with the research of Bernard et al. (2021) which states that students who use e-learning platforms tend to get higher academic results compared to those who only rely on conventional methods.

One of the factors supporting this increase is the flexibility of digital learning that allows students to learn at their own pace [32]; . Reaccessible materials, interactive quizzes, and gamification-based approaches contribute to increased student engagement in the learning process. However, this effectiveness is not universal and is still influenced by the level of student engagement, access to technology, and their digital literacy. Although the majority of students experienced an increase in academic scores, the results of this study also highlight the challenge of the digital divide which is still a major obstacle. Students with limited access to technology and low digital literacy have difficulty in making the most of digital platforms. These findings are in line with the OECD report (2022), which states that inequality in access to technology can exacerbate the academic gap between students who have and do not have adequate access.

The implication of these findings is the need for more inclusive policies to ensure every student has equal access to educational technology. Technology device subsidy programs, the provision of internet infrastructure in remote areas, and digital literacy training for students and teachers are important steps to overcome this challenge. The results of the study showed that student engagement was closely related to the improvement of their academic performance. Students who are more active in using digital platforms tend to obtain better academic results compared to passive students. This shows that the success of digital learning does not only depend on the existence of technology, but also on how it is used optimally.

One strategy to increase student engagement is to develop more interactive learning methods, such as project-based learning, virtual simulations, and gamification systems that encourage active student participation. Teachers also play an important role in guiding students so that they can use digital platforms effectively, so that their use is not just access to materials but also builds a more immersive learning experience.

5. Implications of Research Results

The findings of this study show that the integration of digital learning platforms with conventional learning methods can improve the effectiveness of learning and student academic outcomes. However, this effectiveness is highly dependent on how teachers are able to utilize technology in the learning process. Therefore, educators

and schools have an important role to play in ensuring that the use of digital platforms is not just a complementary tool, but an integral part of a well-designed learning strategy.

Schools need to actively encourage technology adoption by providing specialized training for teachers in managing digital learning effectively [33]; [34]. This training can include the use of Learning Management System (LMS), the application of technology-based learning methods, the design of interactive teaching materials, and strategies to increase student engagement in the digital environment. In addition, schools can also develop internal policies that ensure equitable use of technology, for example by providing digital laboratories, stable Wi-Fi access, and supporting technology-based learning innovations through collaboration programs between teachers and students.

In addition to training for teachers, it is also important to provide assistance to students in optimizing the use of digital learning platforms. Teachers need to provide clear directions on how best to access and use digital learning features, such as online discussions, interactive practice questions, and technology-based learning simulations. Thus, digital learning is not only a tool, but also a strategic approach that is able to increase the effectiveness of teaching and student engagement in a deeper way.

In order to overcome the challenges of technology accessibility, governments and policymakers in the education sector need to develop more inclusive and sustainable policies. One of the main challenges in the implementation of digital learning is the digital divide, where students in remote or underdeveloped areas have limited access to technological devices and adequate internet networks [35]. To overcome this problem, the government needs to allocate a special budget to support the provision of digital devices for students in areas with limited access, for example through subsidies for the purchase of technology devices or laptop and tablet lending programs in schools in need.

In addition to providing devices, the government also needs to focus on improving internet infrastructure in disadvantaged areas. Many students experience obstacles in digital learning not because of a lack of willpower, but because of an unstable internet connection or exorbitant internet costs. Therefore, policies that support the development of a wider and more affordable internet network are needed, including partnerships with internet service providers to provide internet packages at subsidized prices for students and educators [36]; [37]; [38].

In addition, the policy must also include strengthening digital literacy programs among students and teachers. Educational curricula need to be updated to include digital skills training as part of the teaching-learning process, so that students are not only given access to technology but also trained on how to use it effectively to support their learning.

The results of this study also provide important implications for educational technology (Ed-Tech) companies and developers who are responsible for providing digital learning platforms. One of the main challenges students face is the difference in digital literacy levels, where not all students have the same skills in using learning platforms. Therefore, Ed-Tech platforms need to develop more inclusive and adaptive features, which can tailor the learning experience to students' level of understanding and skills.

One strategy that Ed-Tech developers can implement is to improve personalization features in digital learning platforms. These features can include an artificial intelligence (AI)-based recommendation system that can adapt learning materials to students' level of understanding, analysis of student engagement data to provide feedback to teachers, and interactive features that can increase student learning motivation through a gamification approach. In this way, each student can learn in a way that suits their learning style, without feeling left behind or having difficulty understanding the material.

In addition, Ed-Tech developers also need to ensure that their platform is easy to use and accessible to various groups of students, including those with limited access to technology [39]; [40]; [41]. This can be done by providing a lighter version of the app, offline features for downloadable materials, and a more user-friendly interface for students with lower digital skills. With a more inclusive approach, digital learning platforms can be a truly effective tool in improving the quality of education for all students, without exception.

For students and parents, increasing awareness of the importance of active involvement in digital learning is a key factor in ensuring the effectiveness of the use of technology in the learning process. The results show that students who are more active in utilizing digital learning features tend to experience more significant academic improvements compared to those who only use the platform passively. Therefore, students need to be more proactive in accessing various digital learning resources, such as interactive practice questions, learning videos, and online discussion forums that allow them to discuss and exchange understanding with fellow students and teachers.

In addition, parents also have an important role in supporting digital learning at home. Not all students have enough discipline and skills to learn independently through digital platforms, so guidance from parents is indispensable to help them manage their study time and ensure that the use of technology is carried out productively. Parents can help by supervising children's learning activities, providing motivation, and creating a conducive learning environment at home.

For families with limited access to technology, it is important to find alternative solutions, such as using

facilities provided by schools, accessing public internet networks in libraries or community centers, and arranging a schedule for using shared devices in the family. With more active parental involvement, students can be more motivated to make the most of digital learning and make it part of their learning habits.

6. Conclusion

This study confirms that digital learning platforms have a significant positive impact on students' academic achievement at the secondary education level. The data analysis shows that after using digital learning platforms, students' average academic scores increased by 5.12 points, indicating that the integration of technology in the learning process enhances material understanding, encourages active student participation, and provides flexibility in accessing learning resources.

Success in digital-based learning depends not only on the technology itself but also on other key factors. One of the most influential factors affecting its effectiveness is the level of student engagement with digital platforms. Students who actively use features such as interactive quizzes, educational videos, and online discussion forums tend to experience greater academic improvement than those who use the platform passively. Furthermore, access to technology is also a determining factor in the success of digital learning. Students who have access to adequate technological devices and stable internet connections can be more flexible in utilizing digital learning features.

Challenges related to gaps in technology access and digital literacy remain the main obstacles that need to be addressed. These issues cause inequality in academic achievement among students with limited access to technology.

To overcome these challenges, a more inclusive and sustainable strategy is required to ensure that all students can fully benefit from digital learning. Solutions such as strengthening technology infrastructure in schools, providing more affordable digital devices, and offering digital literacy training from an early age are crucial to enhancing the effectiveness of technology-based learning. When access and literacy barriers are addressed, digital learning platforms can improve students' average academic scores by at least five percentage points. This finding supports Hypothesis 1, which suggests that the use of digital learning platforms can significantly enhance student academic outcomes.

Declarations

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Conflicts of Interest

The authors declare that there are no conflicts of interest related to this research. This study was conducted independently, without any financial, institutional, or personal influences that could bias the findings or interpretations.

All data collection, analysis, and reporting were carried out with academic integrity and transparency, ensuring that the conclusions drawn are solely based on empirical evidence and objective assessments. Furthermore, no external organization or entity had any role in funding, designing, or influencing the outcomes of this research.

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