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Effectiveness of Adaptive Learning Platforms in Accommodating Student Learning Styles

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Abstract— *This study aims to evaluate the effectiveness of adaptive learning platforms in accommodating students' learning styles and their impact on learning outcomes, motivation, and student engagement. The focus of this research is to understand how the personalization offered by adaptive platforms can enhance the quality of education by providing a learning environment tailored to individual needs. The research method used is a qualitative approach with a phenomenological research type, involving in-depth interviews and participant observations of students at SMK Pelayaran Samudera Nusantara Utama Palopo. The results indicate that the adaptive learning platform has a significant positive impact on material comprehension, improved learning outcomes, as well as on student motivation and engagement in the learning process. The flexibility and accessibility provided by the platform also enable students to learn in a manner that is more comfortable and suited to their needs. The implications of this study suggest that integrating adaptive technology in education can be an effective solution for addressing differences in students' learning styles. However, further comprehensive research is needed to explore the application of this technology across various educational contexts.*

Keywords—*Adaptive Learning Platforms, Learning Styles, Personalized Learning*

1 Introduction

In the rapidly evolving digital era, education is undergoing significant transformations. Technology has permeated various aspects of life, including the education sector [1]. One emerging innovation is the use of adaptive learning platforms capable of tailoring teaching methods to students' learning styles. These platforms are designed to accommodate the individual needs of students, helping them learn in the most effective way according to their preferences [2]. Learning style is an important factor in the teaching and learning process. Each student has a different way of absorbing information, and the inability to align teaching methods with learning styles can hinder the effectiveness of the learning process [3].

Adaptive learning platforms offer a solution to this issue by utilizing technology that can identify and adapt learning approaches based on individual learning styles [4]. For instance, a student with a visual learning tendency will receive materials in the form of images or videos, while a student who responds better to auditory learning will receive materials in audio form [5]. Thus, these platforms have the potential to enhance students' learning outcomes by optimizing material delivery according to their respective learning styles [6]. According to cognitive theory, learning style refers to the way individuals process the information they receive [7]. This theory emphasizes that learning involves not only the reception of information but also how that information is processed and internalized [8]. Therefore, it is important to understand that a one-size-fits-all approach in education is no longer relevant. Constructivist learning theory also supports the use of

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adaptive technology in education, highlighting the importance of personalized and relevant learning experiences tailored to students' needs [9].

Despite the great potential of adaptive learning platforms, their implementation and effectiveness remain topics requiring further research. One major issue that arises is to what extent these platforms can truly adapt to students' learning styles and how this affects their learning outcomes. Additionally, there are challenges in ensuring that all students benefit maximally from the use of this technology, particularly in developing countries where access to technology and adequate infrastructure remains a barrier. This research focuses on evaluating the effectiveness of adaptive learning platforms in aligning with students' learning styles and their impact on learning outcomes. The study also examines how differences in learning styles may affect students' interactions with these platforms and whether there are other factors influencing the success of using these platforms in learning environments.

Several previous studies have explored this topic. For example, research by Sundari shows that adaptive learning platforms have the potential to improve student learning outcomes, particularly in subjects like mathematics and science. This study highlights that students using these platforms show significant improvement in conceptual understanding compared to those using traditional learning methods [10]. Further, research by Angkat published findings that adaptive learning platforms can increase student motivation by providing personalized learning experiences. This study also shows that students are more engaged and motivated when they feel that the learning material is tailored to their needs and preferences [11]. Another study by Bali supports these findings, emphasizing that adaptive platforms not only improve academic outcomes but also provide a more inclusive learning experience for students from diverse backgrounds and needs [12].

Although these studies demonstrate the great potential of adaptive learning platforms, there are gaps in the literature regarding how these platforms are implemented in various educational contexts, particularly in developing countries. Additionally, there is a lack of research specifically examining how different learning styles may influence the effectiveness of these platforms in the long term. This study aims to fill these gaps by thoroughly examining how adaptive learning platforms can be effectively integrated into various educational environments and how differences in learning styles affect student interaction and learning outcomes.

The novelty of this research lies in its multidimensional approach that combines the analysis of students' learning styles with the effectiveness of adaptive learning platforms. Rather than focusing solely on academic outcomes, this study also explores the psychological and motivational impacts of using these platforms in learning. Therefore, this research is expected to provide new insights into how adaptive technology can be optimized to enhance the quality of education in various contexts, especially in developing countries.

This research aims to evaluate the effectiveness of adaptive learning platforms in accommodating students' learning styles and their impact on their learning outcomes. Specifically, this study will identify factors that influence the successful use of these platforms in various educational contexts and explore how differences in learning styles may affect students' interactions with this technology. The results of this research are expected to provide practical recommendations for more effective and inclusive implementation of adaptive learning platforms in various educational settings.

2 Method

This research employs a qualitative approach using phenomenological research. This approach is chosen because it allows the researcher to understand and delve into students' subjective experiences in using adaptive learning platforms to enhance their learning styles [13]. Phenomenology focuses on uncovering the meaning of individual experiences, making it suitable for exploring how students interact with learning technology and how it affects their learning styles.

Table 1. Research Informants

Position	Total	Education		Informants Code
		Bachelor's	Master's	
School Principal	1	-	1	SR
Assistant Principal	3	1	2	AS, HP, HS
Teacher	4	3	1	BS, AW, NH, RK
Student	3	-	-	KP, HA, MJ

The data collection techniques used in this study are in-depth interviews and participant observation. In-depth interviews were conducted with students actively using the adaptive learning platform at SMK Pelayaran Samudera Nusantara Utama Palopo. These interviews aimed to explore students' experiences, perceptions, and insights regarding the use of the platform. Participant observation was carried out during the learning process to directly observe students' interactions with the adaptive platform and how it affects their learning process [14]. Data was also collected through document analysis, such as progress reports of students using the platform.

The collected data was analyzed using thematic analysis techniques. The analysis process began with transcribing the interview data, followed by coding the data to identify key themes emerging from students' experiences. These themes were then interpreted and connected with theories of adaptive learning and learning styles. Thematic analysis allowed the researcher to identify patterns and in-depth relationships between the use of adaptive learning platforms and changes in students' learning styles.

3 Findings and Discussion

The results of this study indicate that the use of adaptive learning platforms positively impacts students' learning styles, consistent with findings from previous research. For example, research by Fatmawati reveals that adaptive platforms can adjust teaching methods to individual preferences, ultimately enhancing students' academic performance. This finding is supported by studies [15], which found that personalized learning through adaptive platforms not only increases student engagement but also motivates them to be more active in the learning process. Additionally, research by Wardani shows that adaptive platforms provide a more inclusive learning experience, allowing students from diverse backgrounds to achieve better outcomes. However, this study also identifies challenges in the implementation of these platforms, particularly related to students' adaptation to new technology, which has not been extensively discussed in previous studies [16]. This indicates that although adaptive learning platforms have great potential to improve learning styles, their success heavily depends on students' readiness and adaptability, as well as adequate learning environment support [17]. This discussion underscores the need for further research to explore factors influencing the effectiveness of adaptive platforms in various educational contexts.

Personalized Learning

Adaptive platforms are designed to adjust content, methods, and learning pace based on students' learning styles [18]. For example, students who are more visual learners are often provided with materials in the form of images or videos, while auditory learners might receive more audio materials [19]. This adjustment enhances students' engagement and understanding of the material being taught. The results of this study show that personalized learning through adaptive platforms has a significant impact on students' learning styles. Many students expressed that they find it easier to understand material when it is presented according to their learning preferences [20].

The explanation above aligns with a student's statement: “I prefer learning by watching videos, and this platform provides a lot of material in video format, so I understand faster.” This statement indicates that the adaptive learning platform is able to tailor content to visual learners' needs, leading to improved understanding of the material. The interview results show that students prefer learning through videos because this format facilitates their understanding of the content. When material is presented in visual and audio forms, students feel they can grasp information and concepts faster. This may be due to the visual or auditory learning styles of students, where dynamically presented information is easier to process and remember. The speed of understanding material through videos also suggests that students are more responsive to interactive rather than static learning. Platforms providing extensive video material are a suitable choice for students, as they effectively meet their learning needs and preferences.

Another student added, “I used to have difficulty following lessons because my learning style is more kinesthetic, but now I can follow along better because there are many activities involving movement.” This interview result shows that the adaptive platform successfully accommodates kinesthetic learning styles, which are often challenging to address with traditional teaching methods. The statement reveals that previously the student struggled with lessons due to their kinesthetic learning style, meaning they learn more effectively through physical movement and practical activities. However, over time, the student was able to follow lessons better due to the increased number of activities involving movement, which aligns better with their learning style. This change indicates that when teaching methods are adapted to meet individual learning style needs, such as providing more opportunities for physical activities and practice, learning outcomes become more effective. The student now feels more engaged and able to understand the material better because the methods used are more in tune with their learning style.

Similarly, a student also stated, “I feel more comfortable learning by reading texts and doing exercises on the computer, and this platform provides a lot of material in text format that I can study at my own pace.” This statement emphasizes that the adaptive platform not only tailors content based on learning preferences but also provides flexibility in pacing, which is crucial for students who need more time to understand the material. From this statement, it can be concluded that students feel more comfortable learning through methods that involve reading texts and completing exercises on the computer. They appreciate that the platform provides extensive text materials, as it allows them to learn at their own pace. This suggests that students may have a reflective and independent learning style, where they enjoy a structured learning process that can be adjusted to their personal needs. The comfort in learning this way also indicates that students value the flexibility offered by the platform, as it enables them to delve deeper into the material and learn according to their own timing.

Figure 1. Personalization of Learning

This data shows that personalized learning not only facilitates the learning process but also enhances student satisfaction with their studies, ultimately impacting their academic results. Comfort in learning methods refers to how well students feel aligned and engaged with the teaching methods used [21]. When students feel comfortable, they are likely to be

more focused, motivated, and have higher engagement levels in the learning process [22]. In educational theory, comfort is related to motivational theories such as Maslow's Hierarchy of Needs, where the need for safety and comfort must be met before students can reach higher levels of learning [23]. Comfort also plays a role in Information Processing Theory, where a comfortable learning environment helps reduce cognitive load, allowing students to process new information more effectively [24].

Reflective learning style refers to students' preference for reflecting on information before applying or presenting it. Students with this learning style tend to prefer analyzing, thinking deeply, and studying concepts thoroughly [25]. This learning style is associated with Kolb's Learning Styles model, specifically in the Reflective Observation stage, where students observe and reflect on experiences before drawing conclusions [26]. Reflective learning style is also connected to metacognitive approaches in learning, where students actively monitor and regulate their own learning processes [27]. Flexibility in learning is the ability to adjust time, place, and methods of learning according to individual needs and preferences [28]. Flexibility relates to Open and Distance Learning Theory, where students are given greater control over their learning processes [29].

Improving Student Learning Outcomes

Several studies have shown that students using adaptive learning platforms tend to achieve better academic results compared to those learning through traditional methods. Adjusting learning styles helps students understand material in the most effective way for them, thereby minimizing confusion and misunderstandings [30]. This study also found that the use of adaptive learning platforms positively correlates with improved student learning outcomes.

This finding is supported by a teacher's statement: "After my students started using this platform, I noticed a significant improvement in their math scores because they could learn according to their individual preferences." This statement indicates that when students are given the opportunity to learn in a way that best suits their styles and preferences, their academic performance tends to improve. The use of adaptive learning platforms has positively impacted students' academic results, particularly in mathematics. The teacher observed a significant increase in students' scores after using the platform, which allowed them to learn according to their individual preferences. When students are given the freedom and tools to learn in the way that suits them best, they tend to understand the material better, which is ultimately reflected in improved academic scores. This underscores the importance of personalization in learning, where approaches tailored to individual needs and learning styles can enhance learning effectiveness and academic outcomes.

Similarly, another teacher commented: "My students who usually struggle with physics are now showing better understanding because the platform provides many practice problems that they can repeat. This helps them grasp difficult concepts." This indicates that adaptive platforms, with their ability to provide practice tailored to students' needs, can improve understanding of complex subject matter and help students achieve better learning outcomes. The adaptive learning platform has a positive impact on students' comprehension of difficult material, especially in physics. The teacher noted that students who previously struggled with physics are now demonstrating better understanding, largely because the platform offers numerous practice problems that students can repeat. The ability to repeatedly work on exercises and receive immediate feedback helps students reinforce their understanding of challenging concepts. By repeatedly practicing with materials tailored to their needs, students can deepen their mastery of the content and overcome previously encountered difficulties. This emphasizes the importance of repeated practice and personalization in helping students address learning challenges and shows that an adaptive approach can enhance understanding of complex concepts.

Figure 2. Learning Approach

The presence of Figure 2 above indicates that these indicators show that a learning approach tailored to individual student needs has a significant impact on their academic performance [31]. The observed improvement in academic results after the implementation of adaptive learning platforms underscores that when students are provided with tools and materials aligned with their learning styles, they are more likely to comprehend the material and, consequently, achieve better results [32]. Personalization in learning allows each student to learn in the manner that best suits them, whether through visualization, repeated practice, or in-depth explanations [33]. This alignment between learning methods and student preferences is key to fostering higher academic achievement [34]. On the other hand, these indicators also emphasize the importance of providing learning materials that can be repeated and tailored to students' understanding levels. In this context, repeated practice becomes an effective tool in helping students master difficult concepts, especially when the practice can be customized to individual needs [35]. Adaptive learning platforms, with their ability to provide repeatable and personalized exercises, allow students to gradually build a deeper understanding of complex material [36]. Therefore, this approach not only helps improve understanding of challenging concepts but also boosts students' confidence in facing academic challenges.

Student Motivation and Engagement in Learning

Platforms that successfully tailor to students' learning styles usually also enhance their motivation and engagement in the learning process [37]. Students feel more valued and attended to when learning materials are presented according to their preferences, which in turn increases their interest in further learning [38]. Student motivation and engagement in learning also significantly increase with the use of adaptive learning platforms. This is reinforced by an interview with a teacher who said, “I see students becoming more enthusiastic about learning because each day they are faced with new challenges suited to their individual abilities.” This statement shows that adaptive platforms are capable of designing challenges tailored to individual student abilities, which in turn encourages them to be more engaged and motivated in the learning process. When students face challenges suited to their abilities daily, they become more motivated and enthusiastic about learning. The teacher observed that having measurable challenges tailored to individual skill levels plays a crucial role in enhancing students' engagement in the learning process. Adaptive learning platforms that adjust the difficulty level of materials to students' abilities can make learning more engaging and motivating. When challenges are neither too easy nor too difficult, students feel positively challenged, which increases their interest in continuing to learn and develop. This also highlights that personalization in assigning tasks and challenges is a key factor in boosting student motivation.

Similarly, another teacher added, “I noticed that students are more interested in learning because this platform provides immediate feedback on their progress.” This interview result indicates that real-time feedback, a key feature of adaptive platforms, contributes to increased student motivation because they can see their progress in real-time. Providing

immediate feedback on students' learning progress has a positive impact on their interest and engagement in the learning process. The teacher noted that students are more interested in learning when they receive real-time feedback from the platform they use. Immediate feedback acts as a strong motivator for students, as they can see the results of their efforts directly and promptly. When students can monitor their progress, they feel more engaged and motivated to continue learning, as they have a clear understanding of their position and what needs improvement. This quick and relevant feedback helps reinforce understanding and increase students' intrinsic motivation, making them more active in the learning process.

From the two interview results above, the principal also shared their opinion, stating, “I see students becoming more diligent in completing tasks because they can monitor their progress daily, which seems to boost their motivation.” This shows that the progress visualization provided by the adaptive platform can encourage students to continue striving and be more active in completing their assignments. The ability of students to monitor their progress daily significantly contributes to increased diligence and enthusiasm in completing tasks. The principal observed that when students can see their progress periodically, it motivates them to be more consistent and diligent in finishing their assignments. The visualization of learning progress provided by the adaptive learning platform acts as a motivational driver for students. When students can see the improvements they achieve daily, they feel more inspired and driven to continue working hard. This clear and continuous progress monitoring provides a positive psychological boost, which not only enhances students' diligence but also strengthens their overall motivation in the learning process.

Figure 3. Motivation To Learn

From the findings in the figure above, it can be understood that motivation for learning increases when students face challenges that match their abilities, providing them with the drive to continue learning [39]. Adaptive learning platforms that adjust the difficulty level of material to students' abilities help enhance their interest and enthusiasm [40]. Immediate feedback on progress also plays a crucial role in motivating students, as they can see their development in real-time, which encourages them to keep striving and learning [41]. Student engagement in learning is a critical indicator of the effectiveness of teaching methods. When students are given relevant challenges that match their ability levels, they tend to be more actively involved in the learning process [42]. Learning platforms that provide immediate feedback and progress visualization also increase engagement, as students feel more accountable for their progress and are more interested in staying engaged in learning activities.

Diligence and consistency in following learning can be observed from how students continuously complete assigned tasks with enthusiasm [43]. The ability to monitor progress daily provides an additional boost for students to remain diligent in their studies [44]. They can see the results of their efforts each day, which not only enhances motivation but also encourages them to be more consistent in completing tasks and attending lessons [45]. Increased enthusiasm and self-confidence in students are closely related to how they

perceive their progress. Immediate feedback and clear progress visualization help students feel more confident in their abilities [46]. When students see that their efforts yield real progress, they become more motivated to learn and more confident that they can achieve their academic goals. Adaptive learning platforms that adjust materials and challenges according to individual students' needs and abilities are crucial in creating effective and relevant learning experiences [47]. When learning is tailored to each student's unique needs, they feel more valued and supported, which ultimately enhances learning outcomes and engagement in the learning process [48].

Flexibility and Accessibility

Adaptive learning platforms enable students to learn anytime and anywhere at their own pace [49]. This is particularly beneficial for students with special needs or those learning in environments that do not support face-to-face instruction. The flexibility and accessibility offered by adaptive learning platforms are also recognized by many students as important factors in improving their learning outcomes. As supported by a teacher's comment: "My students can learn anytime and anywhere, even when not at school, allowing them to focus better." This statement emphasizes the importance of time and place flexibility provided by adaptive platforms, which allows students to learn according to the schedule and environment that are most comfortable for them. The teacher observed that when students are given the freedom to learn anytime and anywhere, they can more easily find the most conducive times and environments for learning, which in turn enhances their focus and concentration. Learning flexibility allows students to tailor the learning process to their personal needs. By not being bound by specific schedules and locations, students can choose the optimal moments for learning, contributing to improved learning quality. This flexibility also helps students manage their time better, allowing them to allocate sufficient time for in-depth study without interruptions.

Additionally, the principal commented, "When students are sick and cannot attend school, they can still follow the lessons and not miss any material." This indicates that the accessibility offered by adaptive platforms allows students to stay connected with the learning process even if they are not physically present in class. Adaptive learning ensures that students who are ill and cannot attend school remain engaged with the learning process without missing out on material. This highlights that the accessibility provided by the platform plays a crucial role in ensuring continuity of learning for students, even in situations where they cannot be physically present in class. Thus, students can continue to follow lessons, maintain learning consistency, and not fall behind their peers, which contributes to improved academic outcomes and reduced stress due to absences.

Similarly, the vice principal added, "Students feel more at ease in learning because they can review difficult material anytime without having to wait for the teacher's explanation." This statement shows that the flexibility to review material as needed significantly contributes to improving their understanding. Students feel more comfortable and independent in the learning process when they have the flexibility to review difficult material anytime without waiting for the teacher's explanation. This capability allows students to learn at their own pace and gives them the opportunity to deepen their understanding of complex material as needed. This flexibility also reduces dependence on the teacher, allowing students to take initiative in their learning and address their own difficulties, ultimately enhancing learning effectiveness and student confidence in mastering the subject matter.

Figure.4 Adaptive Learning

These findings demonstrate that the flexibility and accessibility offered by adaptive learning platforms not only facilitate learning outside of school hours but also enable students to learn in ways that best suit their needs. Flexibility in learning allows students to study anytime and anywhere, adjusting the learning process to their preferred pace and environment [50]. Aksesibilitas pembelajaran yang tinggi, seperti yang ditawarkan oleh platform adaptif, memastikan bahwa siswa tetap dapat terhubung dengan materi pelajaran meskipun tidak bisa hadir di sekolah, menjaga kelangsungan pembelajaran mereka [51]. High accessibility, such as that provided by adaptive platforms, ensures that students can stay connected with the curriculum even if they cannot attend school, maintaining their learning continuity [52]. Learning continuity is maintained even under conditions that hinder physical presence in the classroom, preventing students from falling behind [53]. All these factors contribute to improved understanding and student confidence, as they can master the material more effectively and feel more prepared to face academic challenges [54]. These indicators show that adaptive learning platforms not only facilitate effective learning but also support holistic student development.

4 Conclusion

The results of this research confirm that adaptive learning platforms have a significant positive impact on learning personalization, improved learning outcomes, student motivation, engagement, as well as flexibility and accessibility in the learning process. An important lesson from this research is that technology designed to adjust to individual learning styles can optimize students' learning potential by providing a more relevant and supportive learning environment. This research also shows that learning personalization not only enhances students' understanding and academic performance but also gives them greater control over their learning process, ultimately boosting their motivation and engagement.

The main contribution of this research to the scientific field is providing a new perspective on the use of adaptive technology in education, particularly in the context of learning personalization. This study updates the approach to how learning can be tailored to individual needs and offers important insights into the effectiveness of technology in enhancing educational quality. However, this research also has limitations, particularly regarding the case, location, and methods used. This study is limited to one school in Malang City with a relatively homogeneous sample in terms of age and background. Therefore, further comprehensive research involving gender and age variations, as well as broader survey methods, is needed to provide a more in-depth understanding and serve as a basis for more targeted educational policy decisions.

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