Ideguru : Jurnal Karya Ilmiah Guru
p-ISSN 2527-5712 ; e-ISSN 2722-2195 ; Vol.10, No.2, May 2025
Journal homepage : https://jurnal-dikpora.jogjaprov.go.id/
DOI : https://doi.org/10.51169/ideguru.v10i2.1835
Accredited by Kemendikbudristek Number: 79/E/KPT/2023 (SINTA 3)
Dinas Dikpora DIY
ideguru Jurnal Karya Ilmiah Guru

Research Articles *– Received: 23/02/2024 – Revised: 04/03/2025 – Accepted: 07/03/2025 – Published: 15/04/2025*

Development of Differentiated E-Learning to Improve Students' Motivation and Learning Independence at SMAN 1 Panggang, Gunungkidul Regency

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Abstrak : This study aims to: (1) develop differentiated e-learning media tailored for SMAN 1 Panggang, Gunungkidul; (2) evaluate the feasibility of the media based on expert validation; (3) assess its practicality for students and teachers; and (4) determine its effectiveness in improving student motivation and learning independence. The research employed the Alessi & Trollip development model, which consists of three stages: planning, design, and development. The initial trial involved three diverse Phase F students, while the product testing was conducted on two classes: a control group and an experimental group, each comprising 36 Phase F students. Data collection included interviews, questionnaires, and validation assessments from material and media experts. Data analysis methods included N-Gain calculations, independent sample t-tests, and paired t-tests. The results of this research and development are as follows: (1) development of a Moodle-based differentiated e-learning platform accessible via www.esman1panggang.com, featuring programming algorithm materials adapted to students' diverse learning styles across four sessions; (2) validation by material experts (4.11) and media experts (4.10), both categorized as "very feasible"; (3) teacher and student practicality assessments rated at 4.19 and 4.55, respectively, indicating the media is "feasible"; and (4) significant effectiveness in enhancing motivation and learning independence, evidenced by higher N-Gain scores in the experimental group compared to the control group, and statistically significant differences in pretest and posttest results ($p < 0.05$).
Keywords: *learning media, e-learning, moodle, learning motivation, learning independence.*

Pengembangan E-Learning Berdiferensiasi untuk Meningkatkan Motivasi dan Kemandirian Belajar Siswa di SMAN 1 Panggang, Kabupaten Gunungkidul

Abstrak: Penelitian ini bertujuan untuk: (1) mengembangkan media *e-learning* berdiferensiasi yang disesuaikan untuk SMAN 1 Panggang, Gunungkidul; (2) mengevaluasi kelayakan media berdasarkan validasi ahli; (3) menilai kepraktisan media bagi siswa dan guru; serta (4) menentukan efektivitasnya dalam meningkatkan motivasi dan kemandirian belajar siswa. Penelitian ini menggunakan model pengembangan Alessi & Trollip yang terdiri dari tiga tahap: perencanaan, desain, dan pengembangan. Uji coba awal melibatkan tiga siswa Fase F dengan karakteristik beragam, sementara pengujian produk dilakukan pada dua kelas: kelompok kontrol dan kelompok eksperimen, masing-masing terdiri dari 36 siswa Fase F. Pengumpulan data dilakukan melalui wawancara, kuesioner, dan penilaian validasi dari ahli materi serta ahli media. Metode analisis data mencakup perhitungan N-Gain, *independent sample t-tests, and paired t-tests.*Hasil penelitian dan pengembangan ini adalah sebagai berikut: (1) Pengembangan platform e-learning berdiferensiasi berbasis Moodle yang dapat diakses melalui www.esman1panggang.com, dengan materi algoritma pemrograman yang disesuaikan dengan gaya belajar siswa dalam empat sesi. (2) Validasi oleh ahli materi (4,11) dan ahli media (4,10), keduanya dikategorikan sebagai "sangat layak". (3) Penilaian kepraktisan oleh guru dan siswa memperoleh skor masing-masing 4,19 dan 4,55, yang menunjukkan bahwa media ini "layak" digunakan. (4) Media terbukti signifikan dalam meningkatkan motivasi dan kemandirian belajar, ditunjukkan dengan skor N-Gain yang lebih tinggi pada kelompok eksperimen dibandingkan kelompok kontrol, serta perbedaan hasil pretest dan posttest yang signifikan secara statistik ($p < 0,05$).
Kata kunci *: media pembelajaran, E-Learning, Moodle, Motivasi belajar, dan Kemandirian belajar.*

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

1. Introduction

In recent years, information and communication technology (ICT) has greatly influenced various aspects of life, including education. ICT is now an essential need in every educational institution to support digital-based learning(Kurniati & Wiyani, 2022). Teachers and students use devices such as gadgets and laptops that can be integrated into the learning process to increase motivation and learning independence (Irfan et al., 2019). Technology makes learning more interesting, speeds up tasks, and makes it easier to understand complex material(Rosnaeni, 2021). The 21st-century education paradigm emphasizes student-centered learning, prioritizing the development of critical thinking skills, creativity, communication, and collaboration (González-pérez & Ramírez-montoya, 2022). Teachers act as facilitators who design innovative learning to prepare skilled human resources for the 21st century (Rosnaeni, 2021). Since the COVID-19 pandemic, the Blended Learning method (a combination of face-to-face and online) has become increasingly relevant. Based on Law Number 20 of 2003, distance education uses information technology and media as a means of learning. BPS 2023 data shows that 91.82% of individuals aged 15–24 years have smartphones, with an average daily usage of 5.4 hours. In addition, 89% of Indonesia's population has used smartphones, and internet users have reached 185.3 million (66.5% of the population), with popular platforms such as YouTube, TikTok, and Instagram (BPS Indonesia, 2023).

Based on the results of interviews conducted at the beginning of the study on August 9, 2024, ownership of gadgets or smartphones by SMA Phase F or class XI students was 100%, students also used the wifi facilities at school to access the internet, in addition, students also had personal email addresses. However, students' use of smartphones and the internet is often used to play games or surf social media, which further reduces their focus on lessons. On the other hand, the use of the internet for education, especially informatics, is still not optimal. The internet should be able to make learning more interesting, which can have a positive impact on the development of learning and increase student motivation.

Education in Indonesia continues to adapt to the demands of the 21st century through the Independent Curriculum which emphasizes computational thinking. Informatics subjects, according to Decree Number 008/H/KR/2022, include mastery of the basic principles of computer system development, algorithms, and programming. Starting to be taught since 2020, the Informatics curriculum is designed in stages from elementary school to high school with the hope that students in Phase F (grades XI and XII) will be able to create structured programs and understand informatics concepts in depth. However, Informatics learning in grade XI still faces obstacles. Students often have difficulty understanding algorithms that are considered complex because they combine mathematics and computer science. Learning motivation is also low because students' interests are more focused on digital entertainment, while differences in learning speed between students create an imbalance. This condition shows the need for more interactive and interesting learning innovations to increase student motivation and help them achieve the goals of the Independent Curriculum.

Motivation plays an important role in student achievement, both from within and from the surrounding environment(Tokan & Imakulata, 2019). Learning motivation encourages students to be more enthusiastic in participating in learning and achieving satisfactory results(Krishan & Al-Rsa'I, 2023). Without motivation, students have difficulty optimizing their potential. According to Keller (2010) , learning motivation includes attention, relevance, belief, and satisfaction that influence student involvement in learning. In 21st century learning, the role of teachers as facilitators is more important than as the main source of information. Teachers must create a conducive learning environment and develop teaching methods that are relevant to students' needs(Bardach & Klassen, 2021). However, in Informatics subjects, there are not yet adequate reference books and the material taught is often too complex for high school students, considering that they have not studied Informatics in junior high school. Algorithm and programming materials require in-depth cognitive mastery, from remembering to creating(Wahyono et al., 2023). Based on the needs analysis through a questionnaire, several problems were found: low student initiative in starting assignments, limited media and guidebooks, and the unstructured learning activities in the computer laboratory. Learning is also limited to class hours, without online access or additional materials. Therefore, innovation is needed to increase student motivation and learning independence.

Independent learning refers to a student-centered learning process using predetermined planning (Ananda, 2019). Its characteristics

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

include persistence, consistency, systematic, goal-oriented, innovative, and clear follow-up. In addition, differentiated learning provides opportunities for each student to learn according to their needs, interests, and abilities (Surjono, 2013). This learning includes differentiation of content, process, product, and environment, with teaching focused on student readiness, interests, and profiles (Mumpuniarti et al., 2023). The implementation of differentiated learning based on e-learning in Informatics can be done by analyzing student needs, choosing a flexible e-learning platform, providing a variety of content, and encouraging student involvement through group projects and online discussions. This will increase student independence in learning. With the development of 21st century technology, e-learning has become an important tool to support interactive and flexible learning (Smaldino et al., 2012). E-learning allows students to learn at their own pace, collaborate online, and access various resources(Surjono et al., 2023). The survey results show that schools have technology facilities that have not been optimally utilized to support learning.

Based on this, learning innovation is needed through differentiated e-learning to increase student motivation, independence, and learning outcomes. Previous studies have shown that e-learning can improve students' independence and learning outcomes. Moodle-based e-learning has also been shown to be effective in improving students' learning outcomes in various subjects. This study aims to develop differentiated e-learning to improve students' independence and learning motivation at SMA Negeri 1 Panggang.

2. Research Methods

This type of research is Research and Development (R&D). The development is conducted scientifically through research, analysis, design, creation of supporting materials, and testing the product's validity (Sugiyono, 2016). The final outcome of this research is the development of an E-Learning product for the Informatics subject for class XI/Fase F at SMA Negeri 1 Panggang Gunungkidul DIY. The author chose the Alessi & Trollip development model because the characteristics of the media being developed in this research align with the steps outlined in the Alessi & Trollip development model, making it the appropriate choice.

The first trial of the development of the Informatics E-Learning was conducted in three stages: alpha testing, beta testing, and product trial (Alessi & Trollip, 2001). Along with the development process, ongoing evaluation was carried out, covering the stages of ongoing evaluation. In the Alpha test, two subject matter experts in the field of Informatics Learning Media for Fase F SMA were involved, namely Mr. Andik Asmara S.Pd., M.Pd., Ph.D., a Lecturer at the Faculty of Engineering, Yogyakarta State University, and Mr. Nanang Pambudi, S.Pd., a teacher at SMAN 1 Panggang. Meanwhile, two media experts in the field of Learning Media were Mr. Dr. Pujiriyanto, M.Pd., a lecturer at the Department of Curriculum and Educational Technology, FIPP UNY, and Mr. Dr. Estu Miyarso, M.Pd., a lecturer at the Department of Curriculum and Educational Technology, FIPP UNY. Beta testing is a formal test fully conducted by the users. The beta testing process involved three students representing three ability levels: high, medium, and low. These students were asked to provide feedback on the produced product by completing an instrument to give input for the final revision.

The Program Trial aimed to assess the effectiveness of the product developed by the author. This process used a Quasi Experimental design with a Pretest and Posttest Design type. The trial involved two classes, Fase F2 with 36 students and Fase F4 with 36 students. Fase F2 class was considered the experimental group, which would be tested with the developed E-Learning product, while the Fase F4 class served as the control group. This research design involved two groups: experimental and control, which were tested before and after the learning process to assess student motivation and learning independence. The experimental group used E-Learning in the learning process, while the control group used conventional learning through PowerPoint. Pretest was conducted to measure the initial conditions of students' motivation and learning independence, while the posttest was conducted after the learning process to evaluate the changes that occurred. The subjects of this trial involved 72 students from SMAN 1 Panggang, divided into two classes: Fase F2 and Fase F4, with 36 students in each class. The Fase F2 class was considered the experimental group to be tested with the developed E-Learning product.

3. Result And Discussion

The development model in this study uses the Alessi & Trollip model, which consists of several stages. First, at the planning stage, problem analysis is carried out through observation, interviews, and literature reviews, which produce key findings such as limited learning media and students' difficulties in

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

understanding the concept of algorithms. Second, the objectives set are to create learning media that support understanding of algorithms, optimize the use of technology, and create learning that is in accordance with the speed and learning style of students. Third, the characteristics of students who are at the formal operational stage need to be considered in developing media that can be adjusted to their learning styles. Fourth, the learning resources used include e-books, videos, and other online materials. Finally, the product idea developed is an E-Learning platform that integrates a differentiation approach to support students' independent learning according to their style and speed.

The second stage is the design stage. At this stage, the author conducts concept analysis, material delivery, assignments, and practice questions to design differentiated E-Learning. The basic concept of E-Learning utilizes Moodle as a flexible and easily accessible LMS. Instructional design considers visual, auditory, and kinesthetic learning styles, with materials tailored through videos, podcasts, and practical exercises such as CodeRunner. Interactivity is also introduced through discussion forums and quizzes. The media design flowchart includes a home page with essential elements such as navigation, information sliders, course lists, and a footer with contact information.

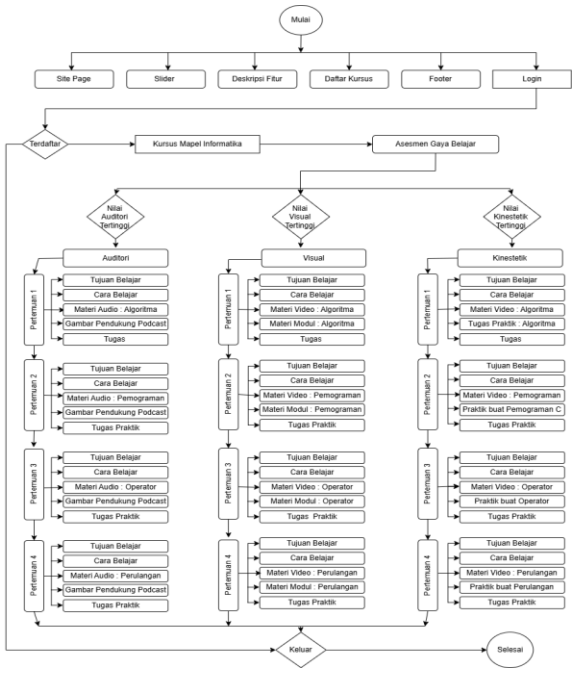

Figure 1. Differentiated E-Learning Learning Flowchart

This theme ensures a professional look with user-friendliness and easy navigation in mind. Responsive design allows your landing page to be optimally accessed from a variety of devices, both desktop and mobile. next stage of development At this stage, the author builds an E-Learning Portal using the Moodle LMS to support differentiated learning. The main goal is to facilitate students in becoming more motivated and independent in studying Informatics subjects according to their learning styles. The steps taken include selecting the appropriate E-Learning application system and determining the domain esman1panggang.com, based on an agreement between the school and the developers, ensuring the portal is easily accessible and meets the needs of the learning development.

The resulting product is a port; e-learning which will then be used at SMAN 1 Panggang as follows:

Figure 2. Domain View And E-Learning Front Page

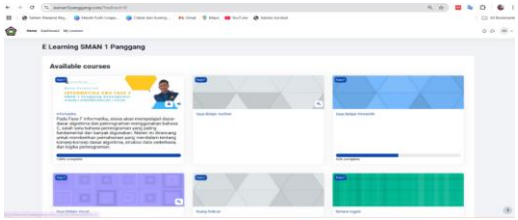

Figure 3: Course view in E-Learning Image

Figure 4. Display of Material About Programming Algorithms in E-Learning

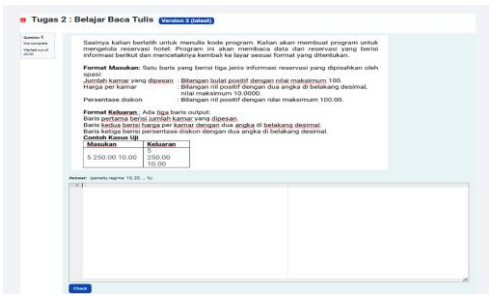

Figure 5. Display of Questions on Programming Algorithms in E-Learning

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

At this stage, the author prepares materials, assignments, and practice questions with a strategic approach to meet the diverse needs and learning styles of students. The materials prepared focus on programming algorithms for grade XI/F Phase, taking into account students' learning styles. Each material is designed to support three main learning styles, namely auditory, kinesthetic, and visual. For students with an auditory learning style, the material is presented through audio recordings or podcasts, while for students with a visual learning style, the material is presented in the form of video tutorials, diagrams, and presentation slides. For students with a kinesthetic learning style, the material is facilitated with practical simulations through the Coderunner plugin for direct programming. Assignments and practice questions are also adjusted to each learning style, allowing students to interact with the material according to their preferences, so that learning becomes more effective and interesting.

The assessment of the e-learning portal development includes three main aspects: Learning, Material, and Language. The validation process carefully evaluates important elements to ensure the relevance and alignment of the material with the learning objectives. The Learning aspect assesses the relevance and achievement of objectives, while the Material Aspect examines the delivery method for effectiveness. Finally, Language and Typography are evaluated for clarity and quality of presentation. The results of the media and material expert evaluation can be seen in the following table.

Table 1. Media Expert Validator Results

No	Aspect	Total Score	Average Score
1	Appearance	112	4.00
2	Accessibility	93	4.22
Total number		205	
Overall Average		4.1	
Overall Percentage		82%	
Overall Quality Criteria		Very Worth It	

Table 2. Results of Material Expert Validators

No	Aspect	Total Score	Average Score
1	Learning	130	4, 02
2	Contents	123	4.1 0
Total number		2 44	
Overall Average		4, 07	
Overall Percentage		8 1 %	
Overall Quality Criteria		Very Worth It	

Based on the assessment results of the two media experts on all aspects, this learning media received the category "very feasible." However, there are still some improvements that need to be made before this media can be used optimally in research. The same thing also applies to the assessment given by the two material experts, who also categorized this learning media as "very feasible," although further improvements are still needed to maximize its use.

Next In the beta trial, three students with different ability levels of low, medium, and high were selected based on the recommendation of the Informatics Subject Phase F teacher to represent the user perspective. Students were given a detailed explanation of the steps of using differentiated E-Learning media so that they could understand how to access and use the materials. During the trial, students recorded various aspects such as material access, learning activities, appearance, language structure, and ease of use. After that, they filled out an assessment instrument to provide feedback on their experience.

Table 3. Results of Practicality Instruments

No	Aspect	Total Score	Average Score
1	Text or letters	15	5.00
2	Color	12	4.00
3	Picture	11	3.67
4	Screen design	11	3.67
5	Test Material	63	4.20
6	Communication features	12	4.00
7	User interface	36	4.00
8	Language	13	4.33
Total number		173	
Overall Average		4.12	
Overall Percentage		82 %	
Overall Quality Criteria		Very Worth It	

Based on the assessment results given by students above on all aspects, the assessment was obtained in the category of " **very feasible** ", however, there are still some improvements that need to be made before this learning media is used optimally in research. Next, in the field trial analysis stage, the results of the study on the development of the E-Learning platform are presented. The purpose of this study is to increase students' interest in learning and independence through a learning platform tailored to their needs. The results of the study were divided into two groups, namely the experimental class and the control class, to compare the impact of using the E-Learning platform on student learning outcomes.

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

Table 4. Recapitulation of Learning Outcomes of

No	Group	Average value		Gains	Classification
		Pretest	Posttest		
1	Control	97.11	99.64	0.06	Low
2	Experiment	96.28	113.64	0.40	Currently

Control Class and Experimental Class

The learning outcomes of students in the control class without differentiated E-Learning media showed an average score of 80, with 25 students above the passing grade (KKM) and 11 students below it. Meanwhile, the experimental class using E-Learning media showed significant improvement with an average score of 88, a highest score of 98, 33 students above the KKM, and 3 students below it. These results indicate that E-Learning tailored to students' learning styles is effective in improving motivation, independence, and understanding of the material. This approach, based on individual needs, encourages student success and motivates them to learn independently.

Next, the practicality test results from the questionnaire filled out by the Informatics subject teacher of Phase F indicate that the differentiated E-Learning instructional tool is rated as highly suitable with an overall average score of 4.36. This assessment covers various aspects, such as text, colors, images, screen design, test materials, communication features, user interface, and language. The highest-rated aspects are text and communication features, which both received a score of 5.00. The teacher's suggestion is to clarify the guidelines or instructions in the E-Learning to help new users access the materials without difficulty. Meanwhile, the practicality questionnaire results filled out by the students of Phase F at SMAN 1 Panggang also indicate a highly suitable rating with an overall average score of 4.55, equivalent to 91%. The aspects with the highest scores are images (4.92) and text (4.89). Overall, students rated the E-Learning tool as very suitable for use, with positive assessments of various aspects, including test materials, communication features, and language.

Next, data collection on student learning motivation was conducted through pretest and posttest in the experimental and control groups. The pretest aims to determine students' initial motivation, while the posttest is to determine motivation after the learning process. The data obtained were analyzed to evaluate the effectiveness of differentiated E-Learning devices on students' learning motivation. The results of the pretest and posttest can be seen in the following table.

Table 5. Student Motivation Questionnaire

No	Data	Class		Information
		Control	Experiment	
1	Average	80	88	Increased by 10%
2	The highest score	92	98	Increased by 6.52%
3	Value Above KKM	25	33	Increase
4	Value Below KKM	11	3	Increase

The table shows that the average pretest motivation of students in the experimental group was 98.28, while the control group was 97.11. After learning, the average value of motivation of the experimental group became 99.64 and the control group 113.64. The gain test showed that the motivation score of students in the experimental group increased by a score of 0.40 (moderate increase category), while the control group only obtained a gain score of 0.06 (low classification). Next, the student independence questionnaire, Student learning independence questionnaire data was collected through pretest and posttest in the experimental and control groups. The pretest aims to measure students' initial independence, while the posttest is to measure independence after the learning process. The results of the pretest and posttest were analyzed to determine the effectiveness of differentiated E-Learning learning devices on student learning independence.

Table 6. Data from the Student Independence Questionnaire

No	Group	Average value		Gains	Classification
		Pre test	Post test		
1	Control	82.36	84.89	0.08	Low
2	Experiment	83.92	100.33	0.34	Currently

The results of the pretest for student learning independence show an average of 83.92 in both the experimental and control groups. After the learning process, the average learning independence in the experimental group increased to 84.89, while in the control group, it reached 100.33. The gain test results showed a moderate improvement in the experimental group (0.34) and a low improvement in the control group (0.08).

p-ISSN 2527-5712 ; e-ISSN 2722-2195 DOI : https://doi.org/10.51169/ideguru.v10i2.1835

Another stage is the analysis of the effectiveness test. The analysis of product effectiveness testing aims to evaluate how effective the differentiated E-Learning teaching device is in improving students' motivation and learning independence. Before conducting the effectiveness test, assumption testing on the obtained data was performed, including normality tests, homogeneity tests, and hypothesis tests.

In the normality test, the data on student motivation and learning independence showed that the significance values were greater than 0.05, indicating that the data distribution is normal. Next, the homogeneity test indicated that the pretest and posttest data for both variables (motivation and learning independence) in the experimental and control groups were homogeneous, with significance values greater than 0.05. For the hypothesis test, an independent sample t-test was performed to compare the differences between the experimental and control groups. The results of the test showed that there were no significant differences in motivation and learning independence before the treatment (pretest); however, there were significant differences after the treatment (posttest), indicating that the differentiated E-Learning teaching device had a positive effect. Additionally, the paired sample t-test showed significant differences between the pretest and posttest data for both variables (motivation and learning independence) in the experimental group, indicating that learning with this device was effective in improving students' motivation and learning independence.

4. Conclusion and Suggestion

The development of differentiated E-Learning media at SMAN 1 Panggang Gunungkidul, which took place from September 23 to December 3, 2024, resulted in E-Learning for Informatics with the topic of Algorithms and Programming using Moodle LMS version 4.1 and a paid web hosting at www.esman1panggang.com. This media was deemed highly feasible, based on the initial evaluation through alpha testing by media and material experts, as well as beta testing with students showing a very feasible score. Field trial testing revealed a significant improvement in student learning outcomes in the experimental class compared to the control class, with an average score of 88 in the experimental class. The practicality of the media was also rated highly, with scores of 4.19 for teachers and 4.11 for students. Furthermore, hypothesis testing through independent sample t-tests and paired sample t-tests confirmed that this tool was effective in enhancing student motivation and self-reliance, with results showing significant improvements in both aspects. Overall, this development not only supports students' academic achievement but also increases motivation and self-reliance, reflecting the great potential of technology in education at school.

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