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Development of differentiated e-module using the AppYet application on measurement material at taruna high school

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Abstract

Merdeka Curriculum is designed to meet the challenges of 21st-century skills, focusing on student development, thus requiring differentiated teaching materials that accommodate students' interests and learning styles. This research aims to develop a differentiated e-module using the AppYet application on measurement material for X IPAS 1 students at Taruna high school in Medan, which is feasible, practical, and effective. The research method used is Research and Development (R&D) with a 4D development model that includes Define, Design, Develop, and Disseminate. The research subjects were 20 students in class X IPAS 1 at Taruna high school . The research instruments used were validation questionnaires, teacher and student response questionnaires, and validated test questions. The data analysis technique used the Likert scale to determine feasibility and practicality, and the N-gain to determine the effectiveness of the e-module. The results showed that the developed e-module was highly feasible, validated by material, media, and language experts, with an overall average of 85.92%. The practicality obtained from student responses in the large group test, was 87.35%, categorized as very practical, while the responses from the physics teacher were 90.3%, also categorized as very practical. The effectiveness of the e-module, determined using the N-gain based on pre-test and post-test results, was 0.774 or 77.4%, indicating that the e-module is effective for use in learning activities. Based on the research results, it can be concluded that the developed e-module is proven to be highly feasible, practical, and effective, thus facilitating more structured and organized learning by providing content tailored to the learning styles of each student.

Keywords: e-module; differentiated learning; AppYet; VARK; merdeka curriculum.

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INTRODUCTION

According to cognitive development theory, students' learning styles vary depending on their cognitive development levels, resulting in different characteristics for each student (Kremneva et al., 2020). The Ministry of Education, Culture, Research, and Technology (Kemendikbud, 2022) aims to improve the quality and relevance of education, focusing on student development to realize the Pancasila student profile through the Merdeka learning curriculum. Differentiated learning aligns to enhance quality by focusing on student development.

Differentiated learning aim to create a diverse classroom environment by providing opportunities to access content, process ideas, and enhance student outcomes (Marlina, 2019). Digital learning must be integrated with differentiated learning because all students are part of the digital native generation (Marciniak, 2010), and if the learning process uses information technology, students will gain an optimal learning experience (Newby & Cheng, 2020). Differentiated learning in the digital realm can be integrated through information technology, such as interactive learning resources, digital content, software, or simulations (Hasanah et al., 2023).

Based on interviews with physics teachers, Taruna high school in Medan has already implemented the Merdeka Curriculum for grade X in the 2023/2024 academic year. Teachers know differentiated learning but have not yet applied it in the classroom. The lack of socialization regarding differentiated learning has resulted in the varied learning styles of students not being accommodated. Observations of 20 students in class X IPAS 1 at Taruna high school revealed that 40% have an audiovisual learning style. Another 40% of students have a reading-writing learning style, while 20% have a kinesthetic learning style. Initial observations through questionnaires distributed to class X IPAS 1 students indicated that their interest in learning and understanding of physics is relatively low. Differentiated e-modules are highly needed in physics learning to help students understand the material without time and place constraints while accommodating their diverse learning styles.

AppYet is an online service that allows users to create Android applications without requiring programming skills. This platform supports various features such as RSS/Atom, HTML5, Podcast, YouTube, TapaTalk, Forum, Twitter, and Mapbox (Syahputra, 2017). According to R. Sanjaya et al., 2019 AppYet provides an intuitive interface for customizing the appearance of modules, including options for customizing colors, fonts, and layouts. Once the setup is complete, save the changes and preview the application to ensure the module is working as desired. Based on the problems presented, a teaching material solution was provided in the form of differentiated e-modules using digital technology with AppYet. According to Sari & Siahaan (2022), differences in learning styles that are accommodated to improve student learning outcomes require effective electronic modules. Several studies, such as Elisa et al. (2023) and Agustina et al. (2023), have proven that differentiated e-modules are needed to improve learning outcomes and accommodate students' learning styles. These modules can also be digital to better cater to students' diverse learning preferences. This aligns with the research by Ramadhan & Wahyuni (2021) and Auliya & Nurmawati (2021), which applied digital technology like AppYet to develop e-modules that are feasible, practical, and effective.

Based on the background described, the researcher is interested in conducting a study titled "Development of Differentiated E-Module Using the AppYet Application on Measurement Material at Taruna high school in Medan." The aim is to develop a differentiated e-module using the AppYet application for measurement material for X IPAS 1 students at Taruna high school in Medan that is feasible, practical, and effective, thus accommodating the various learning styles of students.

METHODS

The research and development (R&D) method is used in product creation to test its effectiveness (Sugiyono, 2017). The product of the research is instructional material in the form of a differentiated e-module using the AppYet application for Measurement material. The study adopts the 4D model, which consists of four stages: Define, Design, Develop, and Disseminate. The sampling technique used is purposive sampling, considering the differences in students' learning styles (Sugiyono, 2016).

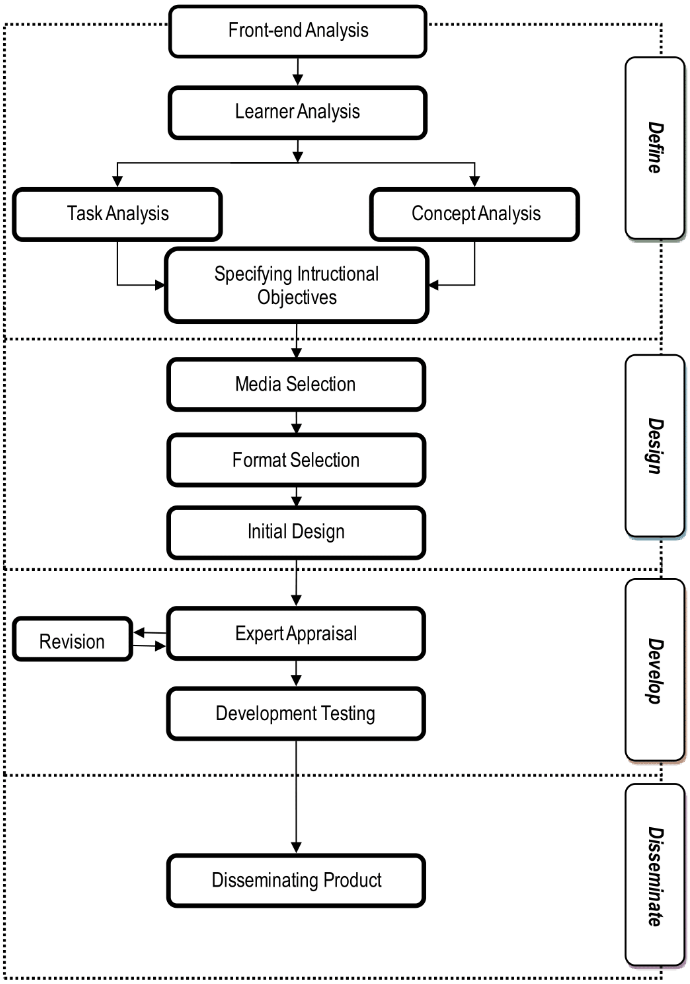

Figure 1. Research Prosedure

The sample for this study consists of X IPAS 1 students at Taruna high school in Medan . Data collection techniques include a feasibility questionnaire validated by content, media, and language experts, while practicality is assessed through student and teacher responses. Interviews were conducted at the outset of observations to understand the physics learning process, challenges faced, and the curriculum used. Other instruments used in the study include pre-test and post-test questions to measure the effectiveness of the differentiated e-module using the AppYet application on Measurement material. Data analysis employs the Likert scale to evaluate individuals' or groups' attitudes, opinions, and perceptions on a topic or issue. The assessment scores for answer choices are detailed in Table 1.

Table 1. Likert Scale

No	Category	Statement Score	
		Positive	Negative
1	Strongly Agree	4	1
2	Agree	3	2
3	Disagree	2	3
4	Strongly Disagree	1	4

Data analysis of the effectiveness of the AppYet application to measure the developed measurement material involves analyzing learning outcomes to evaluate the success of the differentiated e-module. Student learning outcomes from pre-tests and post-tests are then used to analyze the success of the e-module using the gain index (Hake, 2007).

$$Normalized\ Gain\ (g) = \frac{(posttest\ score)-(pretest\ score)}{maximum\ score-pretest\ score} \tag{1}$$

RESULT AND DISCUSSION

Define Stage

The define stage includes front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. The front-end aims to identify problems in the learning process, revealing that there is a low utilization of digital technology to optimally accommodate different student learning styles. Learner analysis is conducted by gathering information about their characteristics and needs through questionnaires, which showed that students' interest in learning and their understanding of physics concepts are relatively low.

Task analysis identifies and examines the learning tasks that must be included in the e-module based on students' learning styles. Tasks assigned to audiovisual learners include creating tutorial videos, infographics, and visual posters. Tasks for read-write learners include creating a guide for a measuring tool, writing essays, and analyzing articles. Students with a kinesthetic learning style are given hands-on tasks such as measuring real objects with different measuring tools, collecting data, and compiling measurement results. Concept analysis involves determining the concepts that must be presented in the e-module. Measurement material includes various measuring tools, quantities, units, and dimensions, significant figures and scientific notation, as well as measurement uncertainty. This helps establish the objective specifications for the differentiated e-module on measurement material.

Design Stage

The e-module is developed using AppYet to convert content from the website into an interactive and easily accessible application for students. AppYet has features that allow integration with WordPress through RSS feed or API.

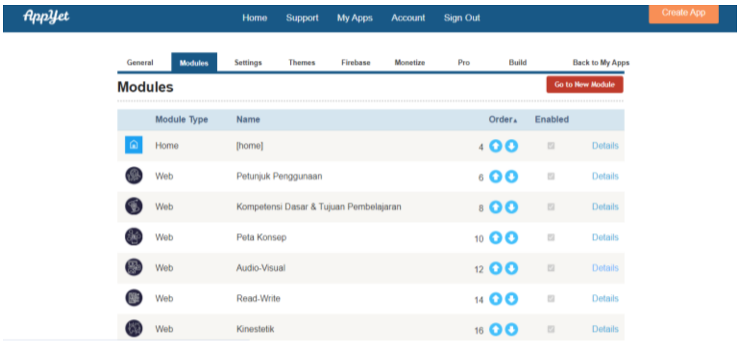

Figure 2. Draft Module on AppYet

Creating e-module content on the WordPress platform facilitates organizing text, images, videos, and other elements. The content on WordPress is arranged in a systematic format, supported by hosting services and plugins, allowing it to be integrated into an application using AppYet. Other media used for designing images, such as e-module icons, include Canva. The e-module also features interactive quizzes using Kahoot and practical simulations from Simphy to help students practice and directly test their understanding.

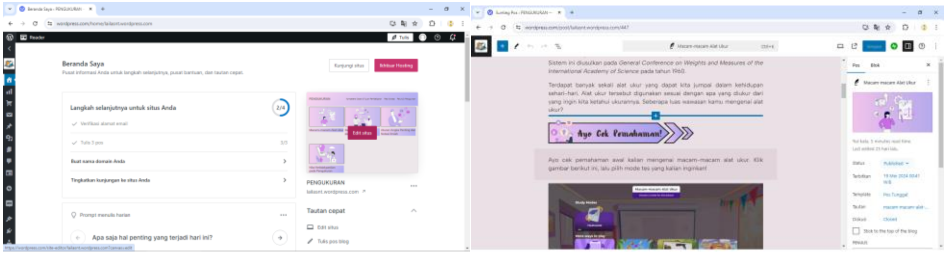

Figure 3. Content Creation on WordPress

Develop Stage

The designed e-module is then developed into a ready-to-use product that can be accessed via Android. The e-module will be evaluated in the development stage by content experts, media experts, and language experts, with validators being lecturers from the Physics Department at Unimed who are experts in their respective fields. Based on the assessment by content experts, an overall percentage of 84.59% was obtained, with a criterion of "very feasible," indicating the accuracy and completeness of the presented content. The assessment by media experts resulted in an average of 82.05%, with a criterion of "very feasible" in terms of appearance and programming. The assessment by language experts resulted in an average of 91.14%, with a criterion of "very feasible," indicating that the language used in the e-module is clear, easy to understand, and conforms to proper Indonesian language rules.

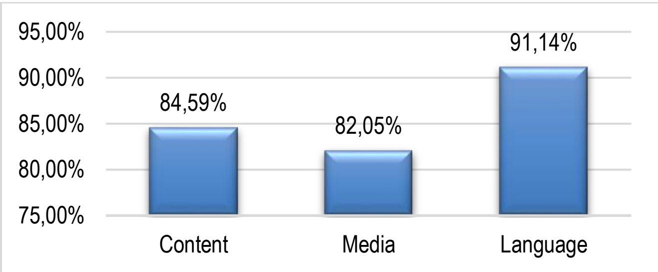

Figure 4. Diagram of Expert Appraisal Results

Based on the assessment of the three aspects in Figure 4, the e-module is categorized as highly feasible with an overall average of 88.92%, which is consistent with the findings of P. A. Sanjaya et al. (2023), Yusra et al. (2023), and Agustina, et al. (2023). Suggestions from the content expert include adding explanations on the calibration of vernier calipers and micrometers. The media expert suggests further developing the e-module to enable offline use, while the language expert suggests adding a glossary menu. The validated and revised e-module is then tested through small group trials. Small group trials are crucial for identifying shortcomings and gathering feedback for further improvements; direct user engagement is essential for evaluating the practicality of the e-module (Zainuddin & Perera, 2018).

Small group trials were conducted with 10 students by distributing questionnaires to assess their responses after using the differentiated e-module. The average practicality rating obtained from the small group of students was 84.7%, indicating it was highly practical. Feedback from students in the small group trial suggested adding quizzes to the main menu of the e-module. Large group trials were conducted after revising based on feedback from students. In the large group trial, the average practicality rating from student responses in Figure 5 was 87.35%, indicating it was highly practical. Questionnaires on responses were also distributed to physics teachers, revealing an average practicality rating of 90.3%, which aligns with the findings of Elisa et al. (2023), Ramadhan & Wahyuni (2021), and Putra et al. (2017).

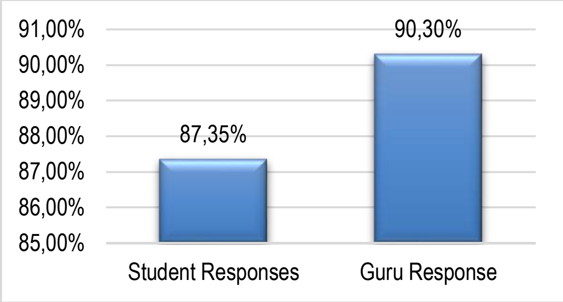

Figure 5. Diagram of Development Testing Results

The effectiveness of the e-module is assessed based on the improvement in students' learning outcomes between the pre-test and post-test. The average score from the pre-test for students was 44.5, while the average from the post-test was 86. Among the students, 10 were categorized as moderately effective and 10 as effective. Variations in the effectiveness of the e-module among students were due to challenges they faced, such as not all having equal access to devices and stable internet connections. Limited internet access can affect learning effectiveness, resulting in varied learning outcomes among students. This aligns with research by Hwang & Chang (2011), which highlights that uneven access to technology can hinder the effectiveness of technology-based learning, as evidenced by the varying learning outcomes among students.

The effectiveness of the e-module is assessed based on the improvement in students' learning outcomes as indicated by the pre-test and post-test scores. The average pre-test score obtained by the students was 44.5, while the average post-test score was 86. There were 10 students categorized as moderately effective and another 10 as highly effective. The variation in the effectiveness of the e-module among students is attributed to challenges they face, such as unequal access to devices and stable internet connections. Limited internet access can impact learning effectiveness, resulting in varying learning outcomes among students. This is consistent with findings from Hwang & Chang (2011), highlighting that unequal access to technology can hinder the effectiveness of technology-based learning, evident in the varied learning outcomes observed among students.

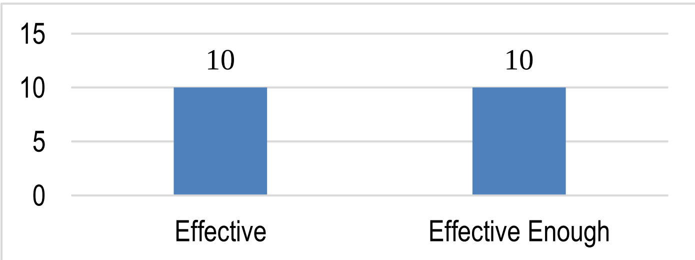

Figure 6. Comparison of Learning Outcomes

The N-gain score in Table 2. averaged 0.774, equivalent to 77.4%. The N-gain score indicates an improvement in students' learning outcomes, demonstrating that the differentiated e-module using the AppYet application effectively enhances students' understanding of measurement materials. This finding is consistent with the research of Chien & Chang (2018), Burhanudin et al. (2023),and Suryani et al. (2023), which suggest that differentiated e-modules are effective in improving learning outcomes according to the needs and learning styles of students. Suwono et al. (2017) noted that despite the potential of differentiated modules to improve learning outcomes, a major challenge remains the uneven access to technology among students.

Table 2. N-Gain Result

Large Group (20 Students)	Learning Outcomes	
	Maximum Score of 100 per Student	
	Pre-test	**Post-test**
Total Score	890	1720
Average Score	44.5	86
N-Gain Score	0.774	
N-Gain Persen Score	77.4%	
Category	Effective	

Nevertheless, the advantage of e-modules lies in accommodating various learning styles of students. They are designed to meet the needs of audiovisual, kinesthetic, and read-write learners, enabling each student to learn in the most effective way for them. E-modules enhance understanding and retention of the material and make the learning process more engaging and interactive. They allow students to learn at their own pace, providing greater flexibility in the learning process. Accessibility and Merdeka learning are additional benefits of differentiated e-modules. They can be accessed anytime and anywhere via Android devices, enabling students to learn outside formal class hours and in environments of their choice. For students who may need more time to grasp the material or prefer learning at specific times and places, e-modules provide significant assistance. Merdeka learning is supported by e-modules, which also offer various resources such as videos, animations, and interactive quizzes to enrich students' learning experiences.

Disseminate Stage

The phased dissemination of the differentiated e-module on measurement topics is carried out through WhatsApp class groups and a website. Once the e-module is developed and revised based on validation and testing, the final product is ready for broader distribution in other classes by teachers to students. The dissemination phase aims to ensure that the developed and revised differentiated e-module on measurement topics can be widely used and positively impact students' learning.

CONCLUSION

Based on the research conducted, it can be concluded that the developed e-module is highly feasible, validated by content experts, media experts, and language experts with an overall average of 85.92%. As indicated by student responses in large group testing, the practicality is 87.35%, while physics teachers rated it at 90.3%, categorizing it as highly practical. The effectiveness of the e-module, measured by N-gain from pre-tests and post-tests, is 0.774, equivalent to 77.4%, demonstrating that the e-module is effective for use in learning activities. Further development for the e-module includes programming content that can be downloaded or accessed offline, addressing the issue of internet connectivity. Providing additional application extensions is also necessary to accommodate device differences such as iOS and PC, as well as further development in other physics topics.

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