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Development of science learning e-module by using authentic learning experience model for the seventh graders

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Abstract

This research determined which e-module for science learning uses the Authentic Learning Experiences (ALE) model. This research used research and development (R&D) as test subjects. Data collection techniques included learning material validation sheets, learning model validation, learning outcome tests, and teacher response questionnaires. Data analysis in this research was conducted using qualitative and quantitative analysis methods. The research results were: 1) A science learning e-module was produced by using the authentic learning experiences (ALE) model for the grade VII students with a very valid category. 2) The practicality of the science learning e-module, which uses the Authentic Learning Experiences (ALE) model to teach changes in substances, is demonstrated by observers' evaluations of teachers rated as excellent. Science learning tools are stated to be very practical. 3) The effectiveness of using science learning e-modules, which employ the Authentic Learning Experiences (ALE) model is assessed through student activities and learning outcomes.

Keywords

Authentic learning experiences (ALE) model, science learning e-module

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Introduction

The issues in Indonesia's educational curriculum necessitate improvements. The existing curriculum is considered inadequate for comprehensive education because it prioritizes knowledge over attitude development. The result is evident in the low morale of students, as seen in several cases that have emerged in the educational world today. Education aims to educate the nation's generations to make the next generation more competent and professional (Fauziyyah & Kuswanto, 2020). According to Law Number 20 of 2003 concerning the National Education System, what is meant by education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual, religious strength, self-control, personality, intelligence, noble morals, and skills needed by themselves, society, nation, and state. Therefore, in national life, education is critical to ensuring the development and continuity of the country concerned. Additionally, a method or strategy is required to shape education according to the unique cultures within this nation. Various techniques are used, starting with improving the curriculum system, both the national and school curricula, or using learning models and strategies that are considered good enough to be implemented (Purwanto, 2018). Education is a highly prioritized field for national development and realizing the ideals of educating the nation's future. Several efforts have been made to improve the quality of education, such as teacher training, learning methods, the curriculum, facilities and infrastructure, and learning resources such as modules.

A module is a set of teaching materials presented systematically so students can learn without a facilitator/teacher (Daichi et al., 2021). Learning with modules is an independent learning approach that focuses on mastering competencies from study materials students study at a specific time according to their potential and conditions (Holisoh et al., 2025). Modules are printed and electronic, with other media such as audio, video, film, and interactive multimedia (Song et al., 2021). The community has widely used e-module media, as evidenced by the widespread implementation of e-modules in educational institutions (schools, training, and universities) (Hidayati et al., 2020). E-modules can also optimize the achievement of learning objectives, even though they are constrained by limited learning time. Using e-modules also reduces learning costs. Before the birth of e-modules, printed module teaching materials were born. However, printed modules were not effective in presenting material clearly, which resulted in students being less interested in learning. In addition, printed modules could not convey historical messages through images and videos (Mulyadi et al., 2019). Through e-modules, the learning process will be more exciting and interactive, convey historical messages through images and videos, and develop students' auditory or hearing senses so that the material presented is easier to understand and follow the flow of developments (Song et al., 2021). Educators and children must adapt to this digital-based era, or what is usually known as the 4.0 era.

E-modules should be a source of information that is easy to observe and use. In essence, media are all forms of intermediaries humans use to convey or spread ideas, concepts, or opinions so that what is expressed reaches the intended recipient. Good media should be easy to operate, and the instructions given should be easy for children to understand and respond

to. The e-module presents flexible and updated material, with content that is relevant, valid, and user-friendly (Mahardika et al., 2022). Based on the results of preliminary observations conducted in class VII.1 at UPTD SMPN 2 Payakumbuh, it was found that during learning, only about 15 students out of 27 were able to follow the lesson well, such as by being active while learning, concentrating, and not making noise in class. The other 12 students were less active in education, including playing games, sleeping, chatting with friends, or doing other assignments during the learning process. In addition, students have yet to be trained to associate learning materials with experiences in the real world. The issue is also due to limited laboratory equipment. There is a shortage of laboratory equipment and experimental materials, particularly chemicals. This causes several obstacles in carrying out practicums.

Science learning activities often include practicums, but with these limitations, teachers usually provide results via video only or by the lecture method. The material, substances, and their changes sometimes constrain the direct experience that students should receive. In general, this problem arises because the teacher's learning model lacks variety, primarily relying on lectures, which results in a teacher-centered approach and leaves students less active in their education.

Moreover, during the earlier phase of acquiring knowledge about substances and their practical applications, only a limited number of experiments took place. This is because laboratory equipment is inadequate for chemistry learning. Students still need to become familiar with the material on substances in chemistry learning. Ideally, teachers use various teaching methods so that students can relate the material they are learning to the real world (Hasnidar & Elihami, 2020). One technique is to vary the learning model (Nurfitriyanti, 2016). The learning model is a conceptual framework used as a guideline in conducting learning that is systematically arranged to achieve learning objectives concerning syntax, social systems, reaction principles, and support systems (Fauzan & Arnawa, 2020).

Authentic Learning Experiences (ALE) is one of the predicted learning models that can effectively address these issues. Through this learning, students are expected to be more motivated to solve problems related to the real world. The Authentic Learning Experiences (ALE) model is significant for student engagement. This process must be adjusted to create students' desire to dig deeper into the content of the material and learning standards. Students in today's classroom must be presented with complex problems and challenges to solve. The action-oriented challenge contextualizes philosophical questions through a challenging inquiry process (Laur, 2013).

Students carry out cognitive activities through the Authentic Learning Experiences (ALE) model and jointly develop their affective and psychomotor abilities (Kristian & Elnanda, 2017). Therefore, by implementing the Authentic Learning Experiences (ALE) model, students will be more able to express their ideas without fear of mistakes in what they make. The Authentic Learning Experiences (ALE) model highly values the diversity of students (Puspita, 2015). In this learning model, students are also required to develop their potential through experiences and assignments given by the teacher.

The authentic learning experience model aims to increase student participation in learning inside and outside the classroom. It involves real-world problems and projects that allow students to explore these issues relevantly (Laur, 2013). In its implementation, students

must also be able to teach classes to improve their learning experience and speaking skills, which can also trigger student learning outcomes to be even better.

The learning model that teachers apply in the classroom is one of the factors determining student learning outcomes. The assessments implemented in this curriculum will be adjusted to the Minister of Education, Culture, Research, and Technology Regulation of the Republic of Indonesia Number 21 of 2022 concerning educational assessment standards for early childhood education, elementary education levels, and secondary education levels.

The results of research conducted by Arigiyati (2016) show that the average percentage of achievement of the activity indicator in cycle I was 51.44% and then increased to 78.85% in cycle II. The classical completion percentage also rose from 50% in the pre-cycle to 69.23% in cycle I and increased to 76.92% in cycle II. Because mathematics learning by implementing an authentic assessment system can increase learning activity and achievement, something similar is also obtained from the results of research conducted by Pratiwi et al. (2019). The results of the study, specifically the t-test, demonstrated a significant difference in the average cognitive learning outcomes between the experimental and control classes. The experimental class achieved more perfect criteria in the psychomotor and affective domains than the control class. The Authentic Learning Experience learning model aims to concretize students' experiences.

Literature Review

Understanding e-modules

A learning module is the smallest unit in a teaching and learning program designed to be studied by students independently or taught to themselves (self-instructional) (Owusu-Mensah, 2019). According to Houghton (2023), a module is the smallest unit in a teaching and learning program that details various aspects, including the instructional objectives to be achieved, the topics to be discussed, the primary material to be studied, and the position and function of the module in the overall program. The module also covers the teacher's role, the tools and resources used, the sequential learning activities, the worksheets to be filled out, and the evaluation program.

E-modules are a form of learning modules designed digitally to support the learning process of individual students. According to Chantarasombat (2022), a module is a unit of planned learning activities organized to achieve learning objectives. A module can also be understood as a structured and systematic teaching material containing learning experiences designed to help students master the material and conduct evaluations. Teachers must identify student needs and plan, design, and create appropriate modules for effective compilation. These elements can increase students' interest and motivation to learn. As the Ministry of Education and Culture (2019) explained, a module contains lesson material arranged in writing and designed so that readers can understand it independently. The module typically includes worksheets, examples, and practice questions to assess student understanding.

Electronic modules (e-modules) are adaptations of printed modules or other teaching materials developed in digital format. According to Dewi et al. (2024), e-modules serve as learning tools that are systematically designed and attractively presented, encompassing

materials, information, methods, limitations, and evaluation methods. E-modules are included in the category of electronic-based learning, which utilizes information and communication technology, especially electronic devices.

Learning using printed modules can be converted into a digital format, an electronic module, or an e-module. Although there is no definite definition of e-module, this term can be interpreted as a combination of modules and electronic learning media, such as e-books. This idea explains that e-modules are structured digital learning materials that support independent learning, so students can learn independently and find solutions. E-modules can also be used as independent learning resources that help students improve cognitive understanding without relying on just one source of information.

The purpose of compiling modules is to provide teaching materials based on the curriculum. In addition, it is necessary to consider students' characteristics and social environment (Daud et al., 2023). A practical module can overcome time and space constraints on learning and increase learning motivation (Dewi et al., 2024). Benefits for students include training independence in learning, allowing for more intriguing out-of-class learning, providing space to express one's learning style, and providing opportunities for self-evaluation. Meanwhile, for teachers, modules help reduce dependence on source books, broaden horizons, and build effective communication with students, which can increase credit scores.

Authentic learning

Authentic learning is an educational approach designed to have real-world significance, enabling students to address actual problems they may encounter. According to Sokhanvar et al. (2021), the benefits of implementing authentic learning for students include (1) enhancing student motivation, (2) identifying learning opportunities, (3) preparing students for a better future, (4) making complex concepts easier to understand, and (5) incorporating elements of learning theory into the educational process. The core principle of authentic learning is rooted in constructivist theory, which encourages students to develop their understanding independently, without relying on teacher support. Joyner and Isbell (2023) further emphasized that learning is not confined to the classroom; it can occur in various settings, motivating students and helping them connect their knowledge with the essential skills needed for their future and everyday life.

In authentic learning, various scenario-based learning designs connect real-world problems with new experiences, helping students prepare for life after graduation (Ahmad, 2020). This approach enhances their knowledge, skills, and values. For instance, Qomariyah (2019) implemented a problem-based learning (PBL) scenario, which led to improved learning outcomes in the experimental group compared to others, giving students a more profound understanding of real-life concepts. As problem-solving becomes increasingly crucial in the twenty-first century, disciplines like mathematics are essential in addressing real-world challenges.

Bhagat and Huang (2017) suggested that technology can be effectively used in authentic learning to (1) assist students in learning within natural environments, (2) help design learning activities, (3) facilitate assessments, (4) serve as a cognitive tool by enabling students to explore

knowledge, (5) address real-world problems in authentic settings, and (6) promote collaboration and communication among groups.

Ifenthaler (2016) integrated scenario design and digital interaction through technology to enhance authentic learning. Examples include automated systems for quality feedback, social systems for collaborative activities, and digital systems to increase teacher participation and improve learning methods. According to Pramesworo et al. (2023), teacher involvement in authentic learning goes beyond delivering content—it involves supporting students in independent learning. Lowell and Moore (2020) noted that the design and implementation of authentic learning tasks allow students to connect academic material with real-world problem-solving.

Drawing on various theories of authentic learning, this study explores the application of authentic learning with technology to help students independently and genuinely construct knowledge through tasks or scenarios based on real-world problems. Developing knowledge through authentic or real-life issues equips students for future challenges, particularly those related to mathematical disciplines. For example, understanding measurement concepts in line segments and angle calculations for schoolchildren forms the foundation for estimating distances and angles in their environment.

Science

According to Szostak (2004), science is a collection of theories tested for truth and used to explain patterns of regularity observed in natural phenomena. Science is an understanding of nature and its phenomena, behaviours, and characteristics, which are packaged into theories and concepts through scientific processes by humans. These structured theories and ideas then inspire the creation of technology that is useful for human life. Science is a collection of knowledge obtained through a systematic discovery process about nature. Science is knowledge obtained through a series of processes that people use systematically to make discoveries about the natural world (Colucci-Gray et al., 2013). This knowledge is characterized by the values and attitudes of the people who use the process. Nola and Sankey (2014) explained that science is theoretical knowledge obtained and compiled in unique ways, such as conducting observations, experiments, and conclusions, compiling theories, and so on, with each step being interrelated. According to Krajcik and Czerniak (2018), science learning must enable students to master science concepts and their relationships, thereby allowing them to solve problems in everyday life with attitudes that align with science values. Students must learn and memorize science concepts and connect them.

Suryawati and Osman (2017) added that in the science learning process, four main elements (attitude, process, product, and application) are expected to be integrated so that students can experience holistic learning. This allows them to understand natural phenomena through problem-solving, scientific methods, and following the way scientists work to identify new facts. Additionally, Giones et al. (2022) argued that science-based learning is a two-way process of transferring knowledge between teachers and students using specific methods (the science process).

Integrated science learning combines physics, chemistry, and biology into one unit. Science taught in an integrated manner in schools is expected to be a means for students to

learn about themselves and the environment. To achieve comprehensive science learning goals, it is not enough to teach science knowledge; it is also necessary to prepare students for how that knowledge is obtained through various learning activities. Understanding science does not stop at obtaining facts, concepts, principles, laws, and theories; it also requires the formation of scientific attitudes and mastery of specific skills.

Thus, it can be said that science learning is an interaction between students and teachers, along with learning resources that combine various fields of science studies, so that students learn about themselves and the environment through scientific methods to solve problems and apply them in everyday life.

Methodology

This research employed a Research and Development (R&D) approach, aiming to produce a science learning e-module based on the Authentic Learning Experiences (ALE) model while testing its validity, practicality, and effectiveness. The R&D research model was chosen because it aligned with the research objectives, which describe phenomena and create innovative educational products. According to Sugiyono (2016), research and development is a systematic method that begins with needs identification, followed by product design, development, implementation, and evaluation. Therefore, this methodology emphasizes an iterative cycle to ensure the resulting e-module meets the needs of students and teachers.

The research subjects were 25–27 seventh-grade students at SMPN 2 Payakumbuh, with varying academic abilities. Seventh-grade students were selected because this grade contains material on changes in matter, which is relatively abstract and requires authentic experiences for easier understanding. In addition to the students, the science teacher in the class was also involved, particularly in developing the product's validation, implementation, and feedback stages. The variation in student characteristics and teacher involvement makes this research representative for testing e-modules in the real context of learning in junior high schools.

The development process involved several stages. The initial stage was a needs analysis, which included identifying learning objectives per the national curriculum, assessing student profiles related to interests, abilities, and learning styles, and mapping resource limitations, such as the lack of science laboratory facilities. This analysis revealed that material on changes in matter was often challenging to understand due to limited classroom practice. Therefore, an ALE-based e-module was a relevant solution for providing a real-life learning experience, even without a fully equipped laboratory. The next stage was product design. At this stage, the e-module was structured according to the Authentic Learning Experiences (ALE) model syntax, which emphasizes student engagement in authentic activities, real-world problem-solving, and group collaboration. The e-module design went beyond text and was enriched with images, experimental videos, interactive quizzes, and simple project-based activities that connect science concepts to everyday life. The design was attractive and user-friendly, providing easy access via computers and mobile devices.

The next stage was development, where the e-module design was implemented using digital media development software. The resulting initial product (prototype) was then validated by subject matter and media experts, including lecturers and science teachers. These validation results served as the basis for improvements before the e-module is piloted in

classroom learning. Following validation, the implementation stage involved applying the e-module to seventh-grade science learning. Teachers used the e-module as a guide and teaching medium, while students utilized it independently and in groups.

The final stage was evaluation, which involved measuring student learning outcomes through pretests and posttests, assessing student and teacher responses through questionnaires, and watching the implementation of learning through observation sheets. The learning outcome test assessed improvements in conceptual understanding after using the e-module, while the questionnaire provided an overview of the product's practicality and appeal. Evaluation was also conducted by comparing student scores against the school-set minimum completion criteria, which was 80. Students were considered to have completed the learning individually if they scored 80 or higher. In contrast, learning was considered complete as a class if at least 85% of students achieved this score.

The research instruments used included a validation sheet to assess content, language, and presentation aspects; an observation sheet to record student and teacher activities during learning; a learning outcome test to measure understanding of science concepts; and a response questionnaire to determine teacher and student perceptions of the e-module. The collected data were analyzed using qualitative and quantitative techniques. Qualitative analysis was conducted on expert validation data, observations, and the questionnaire by categorizing assessments into very valid, valid, moderately valid, or less valid criteria. Quantitative analysis is used to process students' pretest and posttest scores, which are then compared with the minimum completion criteria to determine individual and class completion levels.

The product's success criteria were assessed based on three main aspects. First, validity was determined by expert assessment, demonstrating the appropriateness of the content and design for the curriculum and the Authentic Learning Experiences (ALE) model. Second, practicality was assessed by the implementation of the learning and the positive responses of teachers and students to the ease of use of the e-module. Third, effectiveness was measured by improvements in student learning outcomes, as demonstrated by significant differences between pretest and posttest results, and high levels of student engagement during the learning process.

Furthermore, this research adhered to ethical principles by obtaining school approval before implementation, maintaining student confidentiality, and ensuring data were used solely for academic purposes. All analysis results were presented collectively without identifying individuals. With this structured methodology, the research is expected to produce a valid, practical, and effective science learning e-module based on the Authentic Learning Experiences (ALE) model to improve the quality of learning in seventh-grade junior high school students.

Results

The results show the student learning outcomes before and after implementing the science learning e-module using the Authentic Learning Experiences (ALE) model for grade VII students at SMPN 2 Payakumbuh.

Table 1. *Student learning outcomes pretest and posttest*

Treatment	Learning outcomes	
	Pretest	Posttests
E-model class	7	18
ALE class	2	22

The science learning, which utilizes the Authentic Learning Experiences (ALE) model and focuses on changes in matter, can help students understand the content and achieve satisfactory results based on the learning outcomes achieved. The learning process was conducted both before and after the implementation of the e-module and Authentic Learning Experiences (ALE) classes. In the class that implemented the e-module pretest, only seven people completed the posttest, while 18 people completed it. In the Authentic Learning Experiences (ALE) class, the pretest was completed by only two people, and in the posttest, 13 students completed it. Students in the E-module application class achieve higher average learning outcomes compared to those in the Authentic Learning Experiences (ALE) model class.

Analysis

In developing the science e-module for junior high schools, needs analysis is a critical initial stage. This helps developers understand the learning objectives, student needs, and context. Here are some steps in the needs analysis for developing the junior high school science e-module: (1) Identify clear and specific learning objectives to be achieved through the science e-module. National curriculum standards should consider student abilities and learning challenges faced, and (2) curriculum and standards should be studied, and the applicable science curriculum and relevant learning standards for the high school level. Ensure that the e-module developed includes learning materials from the curriculum and meets the established learning standards. (3) Student profile: Analyze the profile of junior high school students who will use the e-module. Consider students' educational backgrounds, interests, abilities, and learning styles. This will help in designing content that meets students' needs and characteristics. (4) Technological needs: Evaluate the availability and accessibility of technology in the learning environment, including internet access, hardware, and software. Ensure students can access the E-module using various devices, including computers, tablets, or smartphones. (5) Learning content: Identify the most critical and challenging science concepts for junior high school students to understand. Ensure that the E-module develops around these concepts, presenting the content in a clear, engaging, and understandable manner. (6) Interactive needs: Consider the need for interactive elements in the E-module, such as interactive exercises, simulations, learning videos, and formative tests. These elements help increase student engagement and facilitate better understanding. (7) Evaluation capabilities: Ensure that the E-module provides evaluation features that measure student progress and provide appropriate feedback.

Such features can include formative tests, interactive assignments, or independent exercises that students can access. Developers can better identify student needs and learning

environments through a comprehensive needs analysis to produce practical and valuable SMA Science E-modules. The Authentic Learning Experiences (ALE) model for science learning is specifically designed for class teachers and grade VII students at SMPN 2 Payakumbuh, focusing on the topic of changes in matter. The material functions as a guideline in implementing learning. Teaching materials in e-modules used as guidelines are expected to improve the quality of student learning outcomes, specifically in science subjects.

Design

The design of the Science Learning E-module using the Authentic Learning Experiences (ALE) model emphasizes the creation of meaningful, engaging, and relevant learning activities that allow students to connect scientific concepts with real-life contexts. The module's design prioritizes the content structure and pedagogical strategies that foster students' critical thinking, creativity, and collaboration. The guiding principle of the design stage is that learning should not be seen merely as the transfer of knowledge from teacher to student but rather as a process of constructing knowledge through authentic tasks and experiences. Thus, the module is structured so that every activity, explanation, and evaluation exercise encourages students to participate actively in their learning process.

The design begins with the careful selection and organization of content in accordance with the junior high school curriculum. The module transforms scientific concepts related to changes in matter, which are often abstract and challenging for students to grasp, into authentic scenarios that reflect their daily lives. For example, melting, evaporation, or condensation are contextualized through everyday experiences, such as observing boiling water in the kitchen or noticing condensation on a glass of cold water. By framing learning activities in this way, students are exposed to the theoretical aspects of science and guided to recognize the application and relevance of these concepts in their environment. This approach aligns with the Authentic Learning Experiences (ALE) model's focus on bridging the gap between academic knowledge and practical experience.

A crucial component in the design process is the integration of multimedia elements. The module is not limited to text-based explanations but also incorporates images, animations, videos, and interactive simulations to appeal to diverse learning styles. Visual elements illustrate microscopic processes such as particle movement during changes in states of matter. At the same time, videos provide demonstrations of experiments that students may not be able to perform directly due to limitations in laboratory equipment. Interactive quizzes and formative assessments are embedded throughout the module, allowing students to continuously verify their understanding. The design also incorporates reflective questions and problem-solving tasks that prompt students to think critically about real-world issues. For example, students may be asked to analyze the environmental implications of excessive use of chemical substances or to propose simple experiments that can be carried out at home using safe materials.

Its navigational structure and user interface are equally important in the module's design. Since the module is intended for independent learning, clarity, simplicity, and accessibility are prioritized. The layout is designed to be intuitive, with clear instructions and easy-to-follow pathways between sections. Each unit begins with learning objectives in student-friendly

language, followed by explanatory materials, interactive activities, and evaluation tasks. The design ensures students can move through the module at their own pace, revisiting earlier sections if necessary. Furthermore, the module is made compatible with various digital devices, such as computers, tablets, and smartphones, to accommodate the technological conditions of different schools and households.

The design also reflects important pedagogical considerations. The Authentic Learning Experiences (ALE) model requires that students acquire cognitive understanding and develop affective and psychomotor competencies. To achieve this, the module includes collaborative projects where students can work in groups physically in the classroom or virtually through online platforms to discuss and present their findings. It also provides opportunities for self-directed learning, where students can choose additional reading materials or extension tasks according to their interests. The design seeks to nurture student autonomy by embedding such flexibility while aligning with curriculum standards.

In addition, assessment strategies are carefully designed to reflect authentic learning principles. Rather than relying solely on multiple-choice tests, the module incorporates performance-based tasks such as creating reports, presenting findings, and solving real-world problems. These assessments measure content mastery and evaluate higher-order thinking skills, communication abilities, and creativity. Teachers are also provided with guidelines for giving constructive feedback, ensuring that assessment becomes part of the learning process rather than merely a tool for grading.

Finally, the design considers the challenges and potential barriers in implementation. Limited internet connectivity, insufficient access to digital devices, and varying levels of digital literacy among students are anticipated obstacles. To address these issues, the module is designed with offline functionality, allowing students to download and access materials without continuous internet access. Instructions are written in simple language to accommodate students with different levels of prior knowledge. Furthermore, the design emphasizes inclusivity, ensuring the module adapts to diverse learning needs and contexts. Overall, the design stage of the Science Learning E-module using the Authentic Learning Experiences (ALE) model is guided by the vision of producing a resource that is not only scientifically accurate and pedagogically sound but also practical, interactive, and empowering for both students and teachers.

Development

The e-module teaching materials can be used by other science teachers and students of SMPN 2 Payakumbuh public and private middle schools, and become an example for teachers and prospective teachers in creating teaching materials. In addition, teachers and prospective teachers are expected to understand how to develop excellent and correct e-module teaching materials so that students can actively learn, because the materials made by teachers greatly determine student success. This notion aligns closely with the independent learning curriculum's demands, which state that a conducive learning climate encourages an active, creative, effective, and meaningful learning process (Sher & Inamullah, 2025). If teachers realize they are suitable, learning outcomes will be straightforward. The research aims to determine the science teaching materials' validity, practicality, and effectiveness using the

Authentic Learning Experiences (ALE) model.

Evaluation

The average value processing results are compared with the minimum mastery criteria to obtain individual completeness in basic competencies with the material of force and motion. According to Haryanto and Ngadiman (2018), the minimum mastery criterion is a learning completion criterion determined by the educational unit (each school). The minimum mastery criteria value for science subjects at SMPN 2 Payakumbuh is 80. Of the 25 students who participated in the evaluation, all 24 scored ≥ 80; thus, individually, they were declared complete for the material on changes in matter.

Haryanto and Ngadiman (2018) stated that each student is said to have completed their learning (individually) if the proportion of students' correct answers is ≥ 65%. A class is said to have completed its learning (classical completeness) if ≥ 85% of students have completed it. Thus, it can be concluded that learning science with the e-module using the Authentic Learning Experiences (ALE) model improves student learning outcomes.

Conclusion

The development and testing of teaching materials led to the following conclusions. 1) A science learning e-module was produced using the Authentic Learning Experiences (ALE) model in grade VII of SMPN 2 Payakumbuh, with a valid category. 2) The practicality of the science learning e-module, which uses the Authentic Learning Experiences (ALE) model for teaching changes in substances, is evaluated based on observations of its implementation by teachers, who are rated as performing well. The device's practicality is also indicated by the results of student responses from those who participated in learning with the science learning e-module, and both the device and the teachers using it yielded very positive outcomes. People describe the science learning device as highly practical. 3) The research indicates that the science learning e-module, which uses the Authentic Learning Experiences (ALE) model in grade VII of SMPN 2 Payakumbuh, is effective for teaching the material on substance changes, as evidenced by student activities and learning outcomes. Student activity during learning is very high, and learning outcomes show favorable results. Based on the results of validity, practicality, and effectiveness, junior high school teachers can use science learning e-modules that employ the Authentic Learning Experiences (ALE) model as alternative teaching materials for changes in matter. 2) Other researchers can create science learning e-modules based on the Authentic Learning Experiences (ALE) model for different subjects. 3) To enhance the quality of learning devices through improved interactive multimedia, further research is required.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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