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# Development of Adaptive Learning e-Modules in Basic Mathematics for Slow Learners at SMK

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**Abstract**
This study focuses on the development of an E-Module to measure its impact on slow learners at vocational school in Padang, West Sumatra. The research involved 6 slow learner students, utilizing a quantitative approach with a 5-point Likert rating questionnaire. The ASSURE model was employed to analyze the characteristics of each slow learner. The research findings indicate that the practicality level of the E-Module reached 95.87% according to student responses and 96% according to teacher responses, demonstrating the ease of use of the E-Module. Based on the ANOVA test results using Excel, a P-Value of 0.001954 was obtained ($p < 0.05$), indicating a significant difference in the basic mathematics abilities of the students. This study confirms the validity and reliability of the measurement instrument, indicating that the adaptive learning E-Module has a positive impact on supporting the learning of slow learners.

**Keywords**: E-moduls, Adaptive Learning, Slow Learning,

## Introduction

Some slow learners face greater challenges in the learning process compared to their peers. Slow learners are individuals with below-average learning abilities, experiencing delays in mental development and adjustment, which means they require more time and often need to repeat tasks, both academic and non-academic (Zakiah et al., 2022). They need special education because they require more time to understand the learning material (Khaira & Herman, 2020).

The term "Slow Learner" refers to individuals who have below-average learning abilities and often struggle to understand academic concepts at the same pace as their peers. Slow learners typically have an IQ range of 70-90, with variations between 70-85 or 75-89(Krishnakumar et al., 2011). They tend to experience delays in mental development and adjustment, making them require more time and frequent repetitions of tasks (Zakiah et al., 2022). Their characteristics have been widely studied(Banda Sutomo & Herman, 2023; Mansyur, 2022), with one study showing difficulties in intellectual functioning that affect their understanding of instructions and academic materials (Mukhlis et al., 2023).

They often face challenges such as slow response times, difficulty remembering information, emotional instability, and trouble completing tasks quickly (Khusna & Rahmawati, 2023), which lowers their self-confidence and affects their motivation and learning outcomes (Wanabuliandari et al., 2021). Observations at SMK 2 Padang found that teachers still do not understand the characteristics of slow learners. Teachers tend to treat all students the same during learning activities, do not use learning media, and focus more on intelligent students. According to student observations, slow learners feel neglected by teachers, do not understand the material being taught, and tend to be silent and look down during lessons.

Further observations by assistant teachers showed that slow learners have difficulties in language and mathematics. Mathematics education is closely related to abstract symbols and conceptual material. Mathematics often involves using abstract symbols to represent mathematical concepts, operations, and relationships. Understanding and working with these abstract symbols is crucial for developing mathematical proficiency and problem-solving skills. Concepts such as algebraic expressions, equations, functions, and geometric figures heavily rely on symbolic representation in mathematics.

It is important to implement tailored strategies to meet the specific needs of these students(Banda Sutomo & Herman, 2023). Modifying lesson plans to match the pace and learning style of slow learners can improve their understanding and retention of academic content(Ardiana, 2022). By incorporating activities that align with students'

preferred learning styles, such as visual, auditory, or kinesthetic, educators can create a more conducive learning environment for slow learners (Wasqita & Sukoriyanto, 2023). For example, visual learners can benefit from visual aids and diagrams, while kinesthetic learners may excel with hands-on activities and practical demonstrations (Wasqita & Sukoriyanto, 2023). Utilizing e-modules that suit different learning styles, educators can create a more engaging and effective learning experience for students.

E-modules are effective learning media in enhancing the learning process, especially in adaptive learning contexts (Priyono et al., 2022). E-modules are self-study materials presented in electronic format, equipped with hyperlinks for navigation, and include tutorial videos, animations, and audio to enrich the learning experience(I Made Arya Putra Wibisana et al., 2022). Research shows that students using e-modules show different learning outcomes compared to those using only printed modules (Puspitasari et al., 2023). Easy-to-use e-modules can provide significant benefits for students, including those needing additional support. These e-modules can be used in various situations with the guidance of teachers and parents at home. The ease of using technology includes aspects such as ease of learning, control, understanding, flexibility, simplicity, and overall user-friendliness (Ananto & Ambalao, 2022). This includes the ease of learning, understanding, simplicity, and operational convenience of a system (Anggraeni, 2022).

Ease of use not only means learning and using a system but also includes ease of performing tasks, where using the system can simplify tasks compared to manual work (Bahri & Listiorini, 2019). With the various conveniences provided by e-modules, students will more frequently review materials outside of class hours. Repeating the teaching content by students is very effective in improving the learning ability of slow learners (Anggraeni, 2022). Additionally, the use of easy-to-use e-modules can allow children to access educational content comfortably, both in formal learning settings and at home, under the guidance of teachers and parents. By leveraging technology and innovative teaching approaches, educators can create dynamic and effective learning experiences for slow learners, thus fostering their academic development and overall learning outcomes.

## Methods

The research method used is Research and Development (R&D), which aims to produce a specific product and test its effectiveness. According to Sugiyono, 2009, this method focuses on product development and improvement. Tritanto (2017) also states that R&D is a research method oriented towards product development.

The procedure used in this study is the ASSURE development model combined with Tessmer's Formative Evaluation. The ASSURE model development stages consist of six steps Pribadi, 2011: (1) identifying the characteristics of the potential users of the instructional material, (2) determining the competencies and learning objectives, (3) designing the instructional materials, (4) producing the instructional materials. At this stage, in line with Tessmer's Formative Evaluation, product testing is carried out by experts (validators) and one-on-one trials. (5) involving students in using the instructional materials by testing worksheets on a small group, and (6) evaluating and revising the instructional materials through field trials.

The subjects of this research are one educator and six slow learners at SMK 2 Padang. The research instruments used include validation sheets, practical sheets, and interviews. The instrument used to determine the validity of the worksheets is a validation questionnaire. This questionnaire covers several aspects, namely content feasibility, language, and media. The worksheets based on the Elicit Confront Identify Resolve Reinforce model were validated by three lecturers who are experts in their respective fields. The rating scale on the validation sheet uses a Likert scale modified by Riduwan, 2014 with five answer choices: STS (Strongly Disagree), TS (Disagree), N (Neutral), S (Agree), and SS (Strongly Agree).

The data were analyzed by considering all aspects evaluated by the validators and respondents. To calculate the percentage of validity, Equation 1 proposed by Riduwan, 2014 was used. The criteria for product validity and practicality are explained in Table 1.

**Table 1.** assessment score

| Assessment Category | Score |
| --- | --- |
| Strongly Agree (SA) | 5 |
| Agree (A) | 4 |
| Neutral (N) | 3 |
| Disagree (D) | 2 |
| Strongly Disagree (SD) | 1 |

This table provides the scoring system for the assessment categories used in the study, with each category assigned a specific numerical value.

**Figure 1.** the formula for calculating the percentage score (P):

$$P = \frac{\sum R}{N} \times 100\%$$

Detail
1) $\sum R$ = Sum of scores given by validators.
2) N = The total maximum score.

Based on the criteria provided, here is the interpretation for each range of percentage score in terms of validation and practicality:

- 81-100%: Very good, highly suitable/practical.
- 61-80%  : Good, suitable/practical.
- 41-60%  : Fairly good, somewhat suitable/practical.
- 21-40%  : Not good, not very suitable/practical.
- <20%    : Very poor, highly unsuitable/impractical.

These criteria help assess how well the validation and practicality of the product meet the standards based on the percentage of scores obtained.

In this research context, the validity and practicality of the product are evaluated based on the interpretation criteria of the scores obtained as follows: Products are considered Good to Very Good: Scores ranging between 61-100%. They are deemed highly suitable or practical and do not require significant revisions. Products Need Revision: Scores ranging between 0-60%. These products require revision to enhance their validity and practicality. Therefore, determining whether the products meet standards or require revision depends on the range of scores obtained from the assessment of validity and practicality.

**Figure 2**. Steps of the ASSURE research model
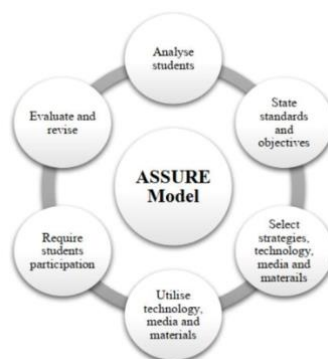


In the stage of analyzing learner characteristics, an analysis of general characteristics, competencies, and learning styles of learners is conducted. The second stage involves setting objectives and selecting methods, media, and teaching materials. During the stage of utilizing methods, media, and teaching materials, active participation from learners is required. Subsequently, product evaluation and revision are conducted. The following is the procedure for developing thematic learning designs using the ASSURE model to enhance learning activities for slow learners.

## Result and Discussion

Adaptive e-modules developed were implemented for slow learner students at SMK 2 Padang. The developed e-modules cover basic mathematics with content including 1. operations with integers, 2. concepts of plane figures, and 3. application of arithmetic in social contexts.

The development of adaptive e-modules utilized the ASSURE development design complemented by Tessmer's Formative Evaluation. The stages in this development research are as follows:

1. Analysis of students

A teacher needs to understand the skills and abilities of the students they teach in order to determine the appropriate direction for learning. Initial assessment or communication with students can provide information to analyze their capabilities. For effective use of instructional media and technology, there must be alignment between student characteristics and the content of teaching methods, media, and materials. Several key factors in making informed decisions about methods and media include: a) General Characteristics: Including basic identifying characteristics such as age, grade level, subject matter, or cultural and socio-economic factors. b) Specific Entry Competence: Refers to the knowledge and skills that students possess or do not possess, including existing skills and target skills for learning. c) Learning Styles: Refers to the spectrum of psychological traits that influence how we process and respond to various stimuli, such as anxiety, talent, visual or auditory preferences, motivation, and others.

Initial analysis of slow learners is conducted by interviewing accompanying teachers and observing students in class during lesson times. Evaluation results indicate that slow learners have abilities below their peers, with academic performance declining by 30%-45% compared to minimum standards, especially in subjects like Bahasa Indonesia and Mathematics. In Mathematics, these children struggle with calculations involving numbers, comparing areas of plane figures, solving social arithmetic problems, and recognizing properties of plane figures. Difficulties in foundational learning make it challenging for slow learners to adapt to continuous learning.

2. State objectives

In education, standards and objectives are essential to assess where each student stands. There needs to be a balance between student needs and requirements. This step creates awareness of that balance. What learning outcomes are expected from each student? What new abilities should students have after completing the course? Objectives need to be stated as clearly as possible. Objectives can be derived from the course syllabus, stated in textbooks, taken from curriculum guidelines, or developed by educators.

At this stage, it is done by determining Competency Standards (SK), Basic Competency (KD), indicators, and learning objectives from the materials to be used, based on curriculum analysis conducted in the first stage. In developing this worksheet, there are three learning activities, where the first learning activity consists of 5 indicators and 7 learning objectives, the second learning activity consists of 7 indicators and 4 learning objectives, and the third learning activity consists of 4 indicators and 4 learning objectives.

3. Selection of material

At this stage, the design and creation of the E-Module follow a structured format comprising a cover page, E-Module description, instructions for use, introduction, table of contents, and a concept map outlining the basic competencies, learning objectives, and instructional materials. This E-Module consists of 3 sessions with 3 sub-topics each, designed according to the characteristics of slow learners.

4. Use of media content and materials
   a. Expert Evaluation

At this stage, the designed E-Module is submitted to experts for feedback. The E-Module is validated by three experts selected based on their respective fields, such as language expert, subject matter expert, and media expert. Validity refers to the reliability and accuracy of the measuring instrument in assessing specific data. Below are the assessment results from the expert reviews.

**Table 2.** Validity Item and Ideality Model (Fit) Item

| No. | Assessment Aspect | Validation Percentage | Category |
|---|---|---|---|
| 1 | Language Experts | 97,17% | Very Valid |
| 2 | Media Experts | 76,66% | Valid |
| 3 | Basic Mathematics Experts | 90,09% | Very Valid |
| | **Average** | **87,97%** | **Very Valid** |

The validator analysis results indicate that the highest assessment aspect is language with a percentage of 97.17%, categorized as highly valid because according to the validators, the E-Module is composed with effective and easily understandable language, without ambiguity, making it easy for students to grasp the content. The lowest percentage is in the media suitability aspect with 76.66%, because according to the validators, some indicators are not suitable and need additional explanations for each displayed image. However, the developed E-Module is still categorized as valid.

According to Riduwan, 2014, validity assessment is determined based on the scores obtained. Validity is classified as valid and highly valid if the score ranges from 61 to 100%. The average overall percentage from the evaluation by the 3 experts reaches 87.97%, indicating that this E-Module is highly valid and suitable for use and testing in the next stage.

5.  Involve students in using teaching materials

In the product trial, conducted with 2 slow learner students at Vocational High School 2 Padang, students explored the developed E-Module focusing on its usability in learning, quality, functionality, and interface. The evaluation results from the students will be analyzed for improvements in the next phase. According to Plomp & Nieveen, 2010, the measurement of practicality assesses whether educators (and other experts) perceive the material as easy to use and suitable for both educators and students. Following this, students are asked to provide assessments, comments, and suggestions on the E-Module they used, aiming to refine it based on their feedback.

The adaptive learning E-module produced has proven to be highly practical based on student responses during the trials. With a response rate of 93.3% in Trial I and 91.2% in Trial II, these results reflect that students have positively responded to the use of the E-module.

6.  Evaluate and revise teaching materials

In this stage, field testing is conducted after revisions based on small group trials. This field testing involves 1 supervising teacher and 6 slow-learning students at SMK 2 Padang. The field test aims to assess the practicality of the adaptive E-module for slow-learning students. Practicality reflects how easily and effectively a media can be used, and to what extent it can be applied in daily life. According to  Akker (1999), the practicality of a media is observed through recognition and efficient use by users and practitioners in everyday situations.

The test involved six students with learning difficulties and one supervising teacher. Aspects evaluated for practicality included learning with a percentage of 95.42%, quality with 96.57%, functionality with 95.23%, and appearance with 96.00%. The assessment results showed that the average percentage of student responses regarding the practicality of the adaptive learning E-module for slow learners was very high, at 95.80%. This indicates that the use of the E-module is highly practical in the context of learning for slow-learning students.

## Conclusion

Based on the assessment results indicating that the E-Module can be used easily and effectively by slow-learning children through electronic devices such as computers or mobile phones, and considering that the instructions and navigation features are designed to be easily understood by them, it can be concluded that this E-Module is a valuable learning tool. The flexibility of using it outside class hours also provides additional benefits, allowing students to learn at their own pace and according to their learning styles. Therefore, the development of this E-Module not only enhances learning accessibility but also supports more independent and effective learning for slow-learning children in their educational environment.

The research instrument in this study meets the unidimensionality requirements so that it shows its ability to measure what should be measured. The results show that the minimum requirement of 20% unidimensionality has been fulfilled and it is also known that the Rasch unidimensional limit has also been met, namely with an achievement above 40%. Furthermore, the independence of items in the instrument is shown by the value of unexplained variance. All aspects have a value below 20% which indicates that the level of independence of the items in the instrument being developed is in the good category. The information obtained from the use of the scale can be used as guidance for counselors in designing service programs or in providing services related to the social skills of junior high school students.

## Acknowlegment

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