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Developing An Assure-Based Mathematics Teaching Module To Enhance Learning Effectiveness

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***Abstract*—** This study aims to develop a Merdeka Curriculum-based teaching module employing the ASSURE model in the subject of mathematics, specifically on the topic of function composition applications, to enhance learning effectiveness as assessed by its validity, practicality, and effectiveness. The study employed the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The instruments used include validation sheets, teacher observation sheets, student response questionnaires, and pretest-posttest assessments.

Based on the validation data analysis, the teaching module received a validity score of 3.83, categorized as highly valid. The practicality analysis, based on teacher observations, yielded a score of 92.8%, which falls under the "very good" category, while the student response questionnaire obtained a score of 89.9%, indicating that the module was applicable without revision. The effectiveness analysis, based on the comparison between pretest and posttest scores, showed an N-Gain value of 0.7442, categorized as high. Therefore, the developed teaching module meets the criteria of being valid, practical, and effective for use in the learning process.

***Keywords*—** ASSURE; Development; Independent Curriculum; Teaching Module.

INTRODUCTION

Education plays a vital role in shaping students' character, intellect, and skills to develop individuals who are competitive and capable of making positive contributions to society. Through education, students are taught a wide range of knowledge, moral values, and social skills that equip them to face future challenges. Education is defined as a conscious and structured effort to create a learning environment and process that is engaging and enjoyable, enabling students to actively develop their potential in order to possess spiritual strength, self-control, character, intelligence, noble morals, and the skills needed for themselves and society (Pristiwanti et al., 2022). The role of educators is crucial in the field of education, as they serve as the frontline actors in the implementation of the learning process.

The role of a teacher extends beyond conducting instructional activities and assessing students' developmental progress; prior to delivering instruction, teachers must design a learning plan that serves as a guide to achieve the intended learning objectives. Instructional design refers to a structured and systematic process tailored to learning needs and objectives (Nugraha et al., 2023). One of the key factors influencing and supporting a successful learning process is the educator's ability to design instruction that is well-structured, incorporates methods responsive to students' needs, utilizes engaging learning media, aligns contextually with the learning goals, and implements the current curriculum (Tanango et al., 2023)

Currently, the curriculum implemented nationwide in Indonesia is the Merdeka Curriculum. However, its implementation has not been fully effective. The lack of teacher attention to students' learning readiness results in students struggling to comprehend the material delivered. Learning readiness refers to a condition in which students' physical, psychological, and material needs are adequately met, preparing them to respond during classroom activities to achieve specific learning objectives (Patri and Heswati, 2021). Teachers can design instructional activities using teaching modules to facilitate the learning process in alignment with the existing curriculum, while also considering students' needs and characteristics through the use of appropriate approaches. In designing teaching modules that align with both students' needs and the current curriculum, the ASSURE model can serve as a valuable framework.

The ASSURE model is a systematic guideline for designing instructional plans, developed through an in-

depth analysis of students' needs. It enables teachers to streamline the learning process by ensuring that every learning activity is grounded in thoughtful analysis and directly aligned with instructional goals (Pujiastuti and Retnosari, 2024). The development of ASSURE-based teaching modules is intended to address challenges in instructional design by offering a structured and systematic procedure. The ASSURE model comprises six phases: (1) Analyze learners; (2) State standards and objectives; (3) Select methods, media, and materials; (4) Utilize methods, media, and materials; (5) Require learner participation; and (6) Evaluate and revise (Lamina et al., 2023). The implementation of ASSURE-based module development is expected to enhance student learning outcomes by taking into account their readiness to learn.

A study relevant to the present study is that conducted by Purwanti (2015), entitled "Pengembangan Media Video Pembelajaran Matematika dengan Model ASSURE" The key difference lies in the focus: while Purwanti's study emphasized the development of instructional media, the current study focused on the development of a teaching module.

Therefore, this study, entitled "Developing an ASSURE-Based Teaching Module to Enhance Learning Effectiveness" was aimed to develop a teaching module that is valid, practical, and effective. It is expected that the findings of this study can be utilized by schools as an alternative teaching module.

RESEARCH METHOD

The type of research conducted in this study was Development Research (DR), which aims to produce a specific product. The product developed in this research is an instructional module for mathematics learning based on the ASSURE model, focusing on the topic of function composition applications.

The development of the instructional module in this study follows the ADDIE development model. The stages of this development research are illustrated in the following diagram (Pujiastuti et al., 2021).

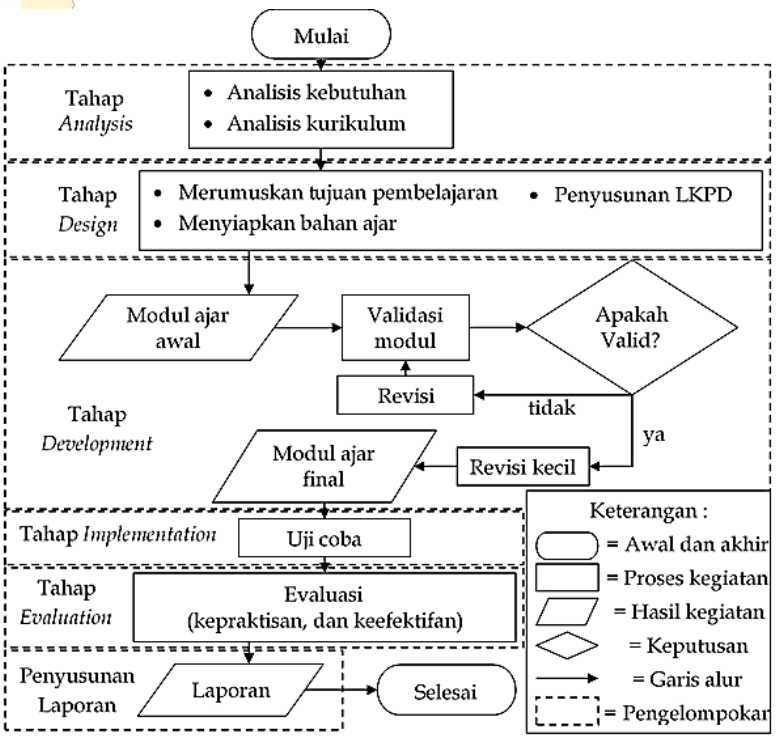

Figure 1. *The Flowchart of the Study*

The following is a description of each stage of the development process (Haryanti and Saputro, 2016).

Analysis

The first stage of this study was the analysis phase. Needs analysis was conducted by examining field data and facts to determine whether the developed product can effectively support its intended users. Curriculum analysis was carried out by identifying the curriculum implemented at the target school.

Design

In this stage, the development of the instructional module was carried out through several steps derived

from the ASSURE model, including formulating learning objectives (state standards and objectives), selecting instructional models, approaches, and learning materials (select strategies and resources), as well as designing student worksheets (utilize resources). This stage also included the preparation of instruments for data collection.

Development

Subsequently, all previously prepared components were integrated to form a comprehensive mathematics instructional module focusing on the topic of function composition in real-life contexts. The completed module was then subjected to validation by expert validators. The validators consisted of one experienced high school mathematics teacher, selected to ensure the developed module aligns with practical classroom needs and to provide feedback based on professional experience, and two university lecturers from the Pre-service Teacher Professional Education (PPG) program in Mathematics. One lecturer specializes in the course on teaching and assessment principles, while the other teaches a course on emerging technologies in teaching and learning—both of which incorporate the design of instructional modules using the ASSURE model as part of the curriculum.

Table 1. *Validity Criteria*

Interval	Validity Criteria
$3.25 \leq Va_{modul} \leq 4$	Highly Valid
$2.5 \leq Va_{modul} < 3.25$	Valid
$1.75 \leq Va_{modul} < 2.5$	Less Valid
$1 \leq Va_{modul} < 1.75$	Invalid

An instructional module is considered valid if it obtains a Va_{modul} score of $2,5-4$. After the validation process is conducted by the validators, revisions (if necessary) are made based on the feedback received to refine and improve the developed instructional module.

Implementation

The validated and revised instructional module was subsequently implemented in a limited trial involving students of Class XI-2 at Surabaya 6 Senior High School. The implementation began with a pretest, followed by the learning process using the developed instructional module, during which an observer monitored the activities. After the lesson, a posttest and a questionnaire were administered to the students.

Evaluation

Following the trial implementation, a posttest and questionnaire were administered to the students. This process aimed to evaluate and analyzed the practicality (based on student response questionnaires and teacher observation sheets) and the effectiveness (based on the improvement of pretest and posttest scores using the N-Gain test) of the instructional module. The following table presents the criteria for evaluating the practicality of the ASSURE-based mathematics instructional module as used in the student questionnaire.

Table 2. *The Criteria of Instructional Module Practicality Based on Student Response Questionnaires (Rhilmanidar et al., 2020)*

$75\% \leq \%RS_{modul} \leq 100\%$	Usable without revisions
$50\% \leq \%RS_{modul} < 75\%$	Usable with minor revisions
$25\% \leq \%RS_{modul} < 50\%$	Usable with major revisions
$0\% \leq \%RS_{modul} < 25\%$	Unusable

An instructional module is considered practical if it obtains a $\%RS_{modul}$ score of 50%-100%.

The following table presents the criteria for evaluating the practicality of the ASSURE-based mathematics instructional module as used in the observation sheets.

Table 3. *The Criteria of Instructional Module Practicality Based on Observation Sheets.*

$75\% \leq \%PRS \leq 100\%$	Very Good

$50\% \leq \%PRS < 75\%$	Good
$25\% \leq \%PRS < 50\%$	Decent
$0\% \leq \%PRS < 25\%$	Poor

An instructional module is considered practical if it obtains a %PRS score of 50%-100%.

The following table presents the criteria for evaluating the effectiveness of the ASSURE-based mathematics instructional module, based on the results of the pretest and posttest using the N-Gain score calculation (Hake, 1999).

Table 4. *The Effectiveness Criteria of the Instructional Module*

N-Gain (g)	**Category**
G > 0.7	High
0.3 ≤ g ≤0.7	Moderate
0 < g < 0.3	Low
g = 0	Failed

An instructional module is considered effective if it obtains a minimum N-Gain (g) score of 0,3.

RESULT AND DISCUSSION

The results of this study consisted of a description of the development process and the outcomes of developing an ASSURE-based mathematics instructional module. The development process involved a detailed explanation of each stage of the ADDIE development model, while the outcomes include the assessment of the module's validity, practicality, and effectiveness. The following section presents a comprehensive overview of both the development process and the results of the ASSURE-based instructional module, specifically designed for the topic of function composition applications.

Analysis Stage

Based on both cognitive and non-cognitive diagnostic data obtained from Class XI-2 at Surabaya 6 Senior High School, there were 33 students with diverse characteristics and varying levels of mathematical ability. Given that most students exhibited a visual-auditory learning style, appropriate instructional materials such as YouTube videos were needed. The non-cognitive diagnostic results, supported by direct observation, indicated that students prefer learning experiences that are connected to their everyday lives.

Furthermore, the cognitive diagnostic data and interviews with the mathematics teacher revealed that students possess a wide range of mathematical abilities. Therefore, it was essential to develop a differentiated instructional module that incorporates the Teaching at the Right Level (TaRL) and Culturally Responsive Teaching (CRT) approaches, along with learning materials and student worksheets (LKPD) tailored to meet the students' specific learning needs.

Designing Stage

1. Formulating learning objectives

Learning objectives were designed to ensure that all instructional activities are well-directed and aligned with the needs analysis and curriculum that have been conducted. According to the Decree of the Head of BSKAP of the Ministry of Education, Culture, Research, and Technology No. 32 of 2024 concerning Learning Outcomes for Early Childhood Education, Primary Education, and Secondary Education in the Merdeka Curriculum, the objectives for Mathematics in Phase F (Grade XI), under the Algebra Dimension, state that by the end of Phase F, students should be able to represent data in matrix form. They should also be able to determine inverse functions, function composition, and function transformations to model real-world situations using appropriate functions (linear, quadratic, exponential).

Based on the Learning Outcomes mentioned above, the learning objectives derived from the needs analysis can be formulated using the ABCD (Audience, Behavior, Condition, Degree) model as follows: (1) Through a group discussion about traditional foods in Surabaya, students will be able to construct a composition of functions from f(x), g(x), and h(x) accurately. (2) Through a group discussion about traditional foods in Surabaya, students will be able to explain the meaning of the results obtained from function composition calculations within the context of real-world problems appropriately. (3) Through a group discussion about traditional foods in Surabaya, students will be able to apply function composition to solve real-world problems correctly. Appropriate tools and methods are

then determined based on learning objectives to assess the extent to which the objectives have been achieved. (Prayogo, 2021)

2. Preparing instructional materials

In the implementation of the Merdeka Curriculum, learning is student-centered, with the teacher acting as a facilitator. Based on the needs analysis, it was found that students tend to prefer learning through videos and hands-on practice. Accordingly, the media and technology utilized include YouTube for instructional videos and digital mathematics tools such as eMathHelp or Photomath.

3. Formulating Student Worksheets (LKPD)

The student worksheets (LKPD) were designed based on the results of the students' needs analysis, differentiating learners according to their levels of understanding by providing varying levels of scaffolding. The student worksheets were also structured to promote active and collaborative participation. Each worksheet includes a QR code linked to Canva, providing access to presentation materials for each group (Yani et al., 2022).

	Kelompok 1	**Kelompok 2**	**Kelompok 3**
Kesiapan Belajar	Peserta didik dengan kemampuan prasyarat komposisi fungsi dengan rentang nilai $n < 70$	Peserta didik dengan kemampuan prasyarat komposisi fungsi dengan rentang nilai $70 \leq n \leq 86$	Peserta didik dengan kemampuan prasyarat komposisi fungsi dengan rentang nilai $n > 86$
Proses Pembelajaran	Peserta didik akan mendapatkan pembelajaran tentang penerapan komposisi fungsi untuk memecahkan masalah dunia nyata, serta guru akan memberikan scaffolding penuh.	Peserta didik akan mendapatkan pembelajaran tentang penerapan komposisi fungsi untuk memecahkan masalah dunia nyata, serta guru akan memberikan scaffolding sebagian.	Peserta didik akan mendapatkan pembelajaran tentang penerapan komposisi fungsi untuk memecahkan masalah dunia nyata, serta guru akan sedikit scaffolding.

The instructional materials that have been prepared were also incorporated into the student worksheet in the form of a QR code, serving as supplementary learning resources for the students.

4. Formulating Pretest-Posttest

Both the pretest and posttest comprised six items of equivalent difficulty. The indicators for these test items are outlined as follows.

Table 5. *The pretest-posttest indicators (Sarkawi & Permana, 2022)*

No	**Pretest**	**Posttest**
1	Constructing the composition of functions f(x), g(x), and h(x).	Constructing a composition of functions f(x), g(x), and h(x) to solve contextual problems.
2	Solving a function composition problem given a specific value of x.	Applying function composition to solve real-world contextual problems.
3	Explaining the range of a function composition when the domain is known	Interpreting the result of a function composition in the context of a real-life problem.

Development Stage

Based on the predetermined learning objectives and the assessments designed to measure their achievement, a student worksheet (LKPD) was developed in alignment with the selected model, methods, and approaches, while also considering students' needs. Upon completion of the design process, all components were integrated into a comprehensive mathematics instructional module based on the ASSURE model. The completed instructional module was subsequently validated by expert validators.

Implementation Stage

The validated instructional module was trialed with XI-2 students at Surabaya 6 Senior High School to determine whether the developed module could enhance the effectiveness of the learning process. A pretest was administered prior to the scheduled instructional session.

During the implementation, pre-service teachers, mentor teachers, and lecturers from the teacher training institute (LPTK) observed the model teacher's instructional activities and completed teacher observation sheets. Following the lesson, students were asked to complete a posttest and fill out a student response questionnaire.

Evaluation Stage

At this stage, the evaluation focused on analyzing the assessment results of validity, practicality (assessed through student response questionnaires and teacher observation sheets), and effectiveness, which was measured through a comparison of pretest and posttest scores.

1. Validity

Table 6. *The Recapitulation of Validity Scores*

No	Description	Validator			K_i
		1	2	3	
1	The learning outcomes and objectives have been clearly formulated	4	4	4	4
2	Local cultural elements have been utilized as part of the learning materials	3	4	4	3.67
3	Diagnostic assessments of students' prior knowledge have been effectively developed	4	4	4	4
4	The Pancasila Student Profile has been properly integrated	4	4	4	4
5	The instructional model employed aligns with students' characteristics	3	4	4	3.67
6	The assessment has been appropriately formulated	3	4	4	3.67
7	Meaningful understanding has been clearly defined	3	4	4	3.67
8	Stimulus questions have been effectively designed	4	4	4	4
9	Learning activities have been adapted to students' characteristics	4	4	4	4
10	Student worksheets have been developed effectively	3	4	3	3.33
11	Instructional materials for students have been appropriately selected	4	4	4	4
12	Student reflection activities have been effectively designed	4	4	4	4
Va_{modul}					3.83

As shown in Table 6, the instructional module obtained an average validity score (Va_{modul}) of 3.83

Subsequently, the average score was matched against the validity criteria outlined in Table 1. As a result, the validated ASSURE-based mathematics instructional module was classified as highly valid.

2. Practicality

Practicality was assessed through teacher observation sheets completed by observers, as well as student response questionnaires. Based on the evaluation of the observation sheets, the average percentage score (APS) obtained was 92.8%. This percentage was then compared to the practicality criteria outlined in Table 3. The results indicated that the ASSURE-based mathematics instructional module was considered practical and fell into the "very good" category

Practicality was also assessed through the student response questionnaire. Based on the evaluation, the overall average percentage score ($\%RS_{modul}$) was 89.9%. This percentage was then compared to the practicality criteria presented in Table 2. The findings indicated that the ASSURE-based mathematics instructional module was considered practical and fell into the category of usable without revision.

3. Effectiveness

The effectiveness of the ASSURE-based mathematics instructional module on the topic of function composition application was evaluated using pretest and posttest scores, supported by a normality test and N-Gain analysis. The results of the normality test are presented below.

Table 7. The Results of Normality Tests

Tests of Normality						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	106	33	.200*	951	33	.143
Posttest	145	33	.076	939	33	.062
*** This is a lower bound of the true significance.**						
a Lilliefors Significance Correction						

Since the results of the normality test showed significance values of 0.143 for the pretest and 0.062 for the post-test, both of which were greater than 0.05, the data were considered to be normally distributed. Therefore, the analysis could proceed with the N-Gain test. The results of the N-Gain analysis are presented below.

Table 8. *The Result of N-Gain Test*

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Can	33	0.22	1	0.7442	0.18801
Valid N (listwise)	33				

As shown in Table 8, the result of the N-Gain analysis was 0.7442. According to the effectiveness criteria outlined in Table 4, this N-Gain score falls into the high category.

This finding is consistent with the study conducted by Purwanti (2015), which demonstrated that the development of instructional modules based on the ASSURE model can enhance learning effectiveness, both in terms of feasibility (practicality) and student learning outcomes (effectiveness).

The results of this study on the development of an ASSURE-based mathematics instructional module for the topic of function composition application further support the theoretical foundation established by previous research. This instructional module can serve as a reference and guideline for the development of other ASSURE-based instructional modules

CONCLUSION AND RECOMMENDATION

Based on the results of the conducted study, it was found that the developed instructional module demonstrated strong validity, high practicality, and substantial effectiveness. The validity score reached an average of 3.83, indicating that the module was highly valid. Practicality, as measured through teacher observation sheets, achieved a percentage of 92.8%, falling into the very good category. Additionally, the practicality based on student response questionnaires yielded a score of 89.9%, indicating that the module was usable without the need for revision. Effectiveness, assessed using the N-Gain test, resulted in a score of 0.7442, which was classified as high.

In light of these findings, it is recommended that educational practitioners continuously pursue innovation in instructional practices that are aligned with the current curriculum and responsive to the specific learning needs of students.

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