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Development of an Android-Based Mobile Learning Module to Improve the Students Critical Thinking Skills

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Abstract: Development of an Android-Based Mobile Learning Module to Improve Critical Thinking Skills of Junior High School. This study's purpose to specify the validity, practicality, and effectiveness of an android-based mobile learning module on simple ventures and aircraft to repair critical thinking skills for middle school students. The development of an android-based mobile learning module on the material simple ventures and aircraft is based on requirements for exact teaching materials for 21st-century learning which identically leverage technology, information, and communication. The method utilized in this research is ADDIE model development design which consists of five stages, namely analysis, design, development, implementation, and evaluation. The results indicated that (1) the percentage of validity of an Android-based mobile learning module was 91.83% obtained from an average of three validators, (2) the percentage of the practicality of an Android-based mobile learning module was 95.48%, (3) the effectiveness score of an Android-based mobile learning module is 0.63 which is acquired from the N-gain test and 95.91% from students response questionnaire so that it can be inferred that the Android-based mobile learning module is valid, practical and effective to repair critical thinking skill of junior high school students.

Keywords: Android; Critical thinking skill; Mobile-learning module; Science learning.

Introduction

Information technology is very important to be implemented in the world of education to balance the speed of development of education with the development of technology and science itself (Mardhiyyah et al., 2022). Implementation of information technology in Indonesian education is very developed, especially in the field of learning media development (Widodo et al., 2021). Science learning is one of the subjects at junior high school level that focuses on disciplines related to process of natural phenomena that occur and their cause and effect (Herowati & Azizah, 2022). Science is knowledge that develops from the experience of natural phenomena and interactions that occur in them (Mardhiyyah et al., 2022). The presence of information in science learning has to verify properly through the reinforcement of students' critical thinking skills with the aim that students can process and understand the information found effectively (Wahyuni et al., 2022).

Critical thinking skills are ability and process in understanding concepts, and apply, synthesize, and evaluate information obtained and produced (Ryzal et al., 2020). Ridlo et al. (2019) say critical thinking skills are part of higher-order thinking in addition to creative thinking which plays a role in solving complex problems. Partono et al. (2021), revealed the reason why critical thinking skills are essential to be mastered by students because they are included in the 21st century or 4C skills (critical thinking, communication, collaboration, and creativity) that students have to be able to follow the progress, especially at field of science.

Critical thinking skills students which low are one of discussion topics in Indonesia education, based on PISA (Programme for International Student Assessment) data Indonesia was ranked 72 out of 79 countries with students who completed high-level

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questions in Indonesia by 1% of 11% from the average OECD (Organization for Economic Co-operation & Development) scores (Bernando et al., 2022). The low ability to think critically can also be seen in outcome from initial analysis in MTS Negeri 1 Jember. The average critical thinking skill in class VIII B students obtained a score of 6,0. The low ability to think critically is affected from several factors, including the lack of learning innovation from teachers which can be seen from the use of some teaching materials that are still in printed form (Ricu Sidiq & Najuah, 2020). One of the efforts to repair critical thinking skills that can be done by teachers is to develop teaching materials based on digital technology (Rizki et al., 2022).

Teaching materials are learning resource materials that are used by both teachers and students to achieve learning goals (Kosasih, 2021). The selection of right teaching materials allows the continuity in learning process to run optimally (Nana, 2020). The most common types of teaching materials are printed teaching materials and non-printed teaching materials. Printed teaching materials include books, handouts, modules, and student worksheets while non-printed teaching materials can be multimedia. Based on the interview results, in learning science class VIII B in MTS Negeri 1 Jember using package books, LKS, PowerPoint (PPT), and Youtube videos as teaching materials. Most of these teaching materials are included in the type of printed teaching materials so they have disadvantage of not being able to present movements and exposure to linear material (Prastowo, 2018). The use of teaching materials tends to be less attractive to students because it is monotonous so it is required to develop teaching materials, one of which is the module.

Learning modules are units of learning activities that have been designed to assist students to achieve learning purposes. The module is learning unit that can operate alone (Mahardika et al., 2021). Currently, many modules have been developed into several forms, one of which is e-module. E-modules are digital teaching materials used to help students learn with the help of computers or androids (Rosidin et al., 2022).

Modules in digital form are learning resources that contain materials, methods, and limitations on how to evaluate with a systematic and interesting design to achieve learning objectives (Rizki et al., 2022). Digital modules can be packaged in mobile form so that they can be adjusted to your needs. Mobile learning or M-learning is a type of learning that provides educational content and materials supported by the use of wireless tools such as smartphones (Faisol, 2022). Learning using mobile learning with smartphones is hoped to prompt learning so that students can utilize technology simultaneously (Almaiah et al., 2022). The implementation of learning using smartphones can have a positive impact on cognitive, metacognitive, and affective students where smartphones can turn learning into an experience (Prima et al., 2022). Based on this description, researchers developed an android-based mobile learning module at ventures materials and simple planes to increase critical thinking skills of middle school students. This development research aims to test validity, practicality, and effectiveness of mobile learning modules.

Method

This research is development research with ADDIE model which has five stages, including analysis, design, development, implementation, and evaluation. The research procedure can be seen in Figure 1.

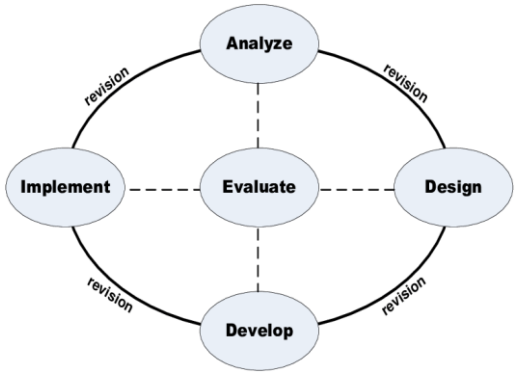

Figure 1. ADDIE Model Flow (Branch, 2009)

The subjects of this research were 32 students of class VIII B in MTS Negeri 1 Jember. Data collection instruments in this research were used (1) validation sheets, (2) implementation observation sheets, and (3) critical thinking ability tests. The validation sheet serves to discover validity of a product developed and product improvement suggestions obtained from three validators. The implementation observation sheet serves to determine the practicality of developed product filled by three observers. A critical thinking skill test is a test used to specify the effectiveness of a product in requirement of critical thinking skills of middle school students.

Data Analysis

The data analysis techniques are (1) validity test, (2) practicality test, and (3) effectiveness test. Validity assessment data is a form of quantitative data which includes content validation and construct validation covering material aspects, presentation aspects, language aspects, and graphic aspects with a scale of 1-4 where each scale has a different category. The score obtained is then calculated as the average score of each

aspect using the equation taken by Nesri & Kristanto, 2020 as follows.

$$V = \frac{T_{SE}}{T_{SM}} \; x \; 100\% \quad (1)$$

Information:
V : percentage of validity
T_{SE} : total score achieved
T_{SM} : total score maximum

After obtaining validity percentage result, then the result is compared with the validity category based on the corresponding criteria. This validity criterion was adopted from Nesri & Kristanto, 2020 as presented in Table 1.

Table 1. Validity Criteria

Criteria (%)	Category
$85 < V \leq 100$	Highly valid
$70 < V \leq 85$	Valid
$50 < V \leq 70$	Less valid
$V \leq 50$	Invalid

The practicality of product is retrieved from observation in implementation of learning. Practicality assessment data is a form of quantitative data with a scale of 1-4 where each scale has a different category. The scores obtained are then analyzed by counting average score of each learning activity using equations taken by Nesri and Kristanto (2020), as follows.

$$P = \frac{T_{SE}}{T_{SM}} \; x \; 100\% \quad (2)$$

Description:
P : percentage of practicality
T_{SE} : total score achieved
T_{SM} : total score maximum

After obtaining the result on percentage of practicality, then the results are compared with the practicality category based on the corresponding criteria. This practicality criterion was adopted from Nesri and Kristanto, 2020 as presented in Table 2.

Table 2. Practicality Criteria

Criteria (%)	Category
$85 < P \leq 100$	Very practical
$70 < P \leq 85$	Practical
$50 < P \leq 70$	Less practical
$P \leq 50$	Impractical

The effectiveness test consists of two analyses, namely the analysis of critical thinking skill test and the analysis of student response questionnaire. Analysis of critical thinking skill tests using N-gain calculations to specify the increase in students' critical thinking skills. The N-gain formula by Hake (1998), is as follows.

$$(g) = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (3)$$

Description:
(g) : score average gain which is normalized
S_{post} : score average tes end learners
S_{pre} : score average initial test learners
S_{max} : score maximum ideal

Once the scores are normalized, then the results are compared with the N-gain category based on the criteria adopted by Hake, 1998, presented in Table 3.

Table 3. N-gain Criteria

Criteria	Category
$g \geq 0.7$	High
$0.3 < (g) \leq 0.7$	Medium
$g < 0.3$	Low

The analysis of student response questionnaires was calculated using equations taken from Khairiayah (2018), as follows.

$$RS = \frac{T_{SE}}{T_{SM}} \; x \; 100\% \quad (4)$$

Description:
RS : percentage of learner response
T_{SE} : total score achieved
T_{SM} : total score maximum

After the results of student response questionnaire are analyzed, then the results are compared with the category of student responses based on the appropriate criteria. These student response criteria were adopted from Khairiyah, 2018, as presented in Table 4.

Table 4. Student Response Criteria

Criteria (%)	Category
$85 < RS \leq 100$	Very positive
$70 < RS \leq 85$	Positive
$50 < RS \leq 70$	Less positive
$RS \leq 50$	Not positive

Result and Discussion

The development of mobile learning modules empowers communication and information technology on learning concepts that have benefits in availability of teaching materials that can be retrieved every time and interesting visualizations (Prima et al., 2022). Development of mobile learning module using ADDIE

model with a description of the stages as follows.

Analysis Stage

The analysis stage is aimed at identifying needs before developing a product. The analysis conducted includes an analysis of student needs, curriculum analysis, product analysis, and goal analysis. Through the analysis of student needs, it is known that the teaching materials used by class VIII B MTs Negeri 1 Jember have not utilized modules, but are limited to science package books, PowerPoint, and Youtube videos. According to students, this makes the learning atmosphere feel monotonous.

Curriculum analysis to find out the curriculum that applies in schools so that researchers can adjust the sources of content and technology that will be used in learning. The curriculum used by MTs Negeri 1 Jember has currently revised 2013 curriculum. Product analysis to customize features in teaching materials to suit the needs of learners. Teaching materials developed by researchers can be used practically in a variety of circumstances. Analysis of objectives to determine learning objectives based on indicators of critical thinking ability with venture material and simple aircraft.

Design Stage

Design stage to design a product appropriate to the results from analysis. Android-based mobile learning module has an output android smartphone application that can be accessed anytime and anywhere. The first step in design stage is to create a module design using Canva so that the content looks more attractive. Mobile learning is made using codulars, from design generation to programming data to produce interactive teaching materials.

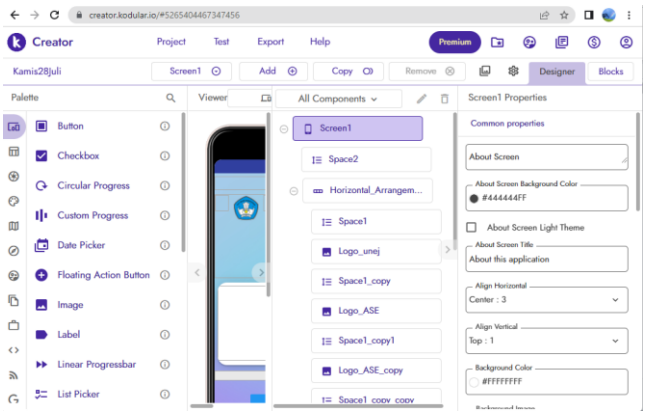

Figure 2. The process of making a mobile learning module through codular

Development Stage

Development stage to produce products based on the design stage. The display of android-based mobile learning modules that have been developed show in Figure 3.

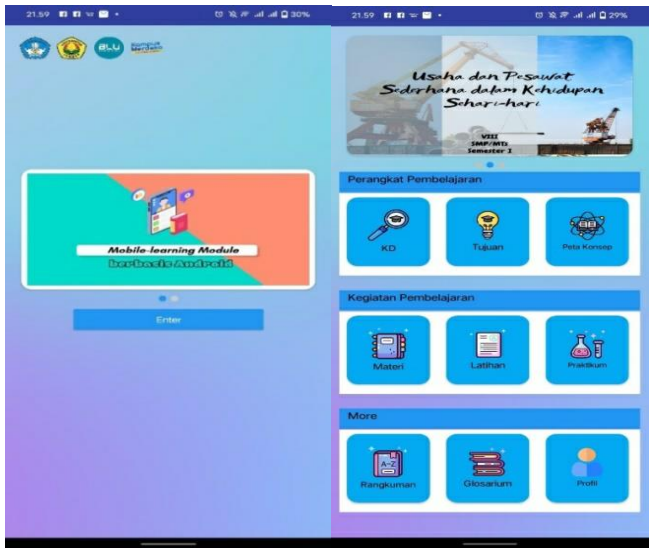

Figure 3. Cover and main menu

The opening is cover as the first display that appears. The main menu is a display to go to a page that student wants. The learning tool consists of basic competencies, learning objectives, and concept maps. Learning activities are divided into learning materials, practice questions, and practicums. The more section consists of a summary of learning materials, a glossary, and a profile of the developer.

Implementation Stage

Implementation stage includes the assessment step at android-based mobile learning module by validators and test stage of a large class of 32 students. The validation results and observation results are as follows.

Table 5. Product Validation Results

Assessment Aspects	Validator Percentage (%)			Average (%)	Category
	1	2	3		
Validity of Contents	100	83	92	92	Highly Valid
Material Aspects	88	79	96	88	Highly Valid
Presentation Aspects	95	90	100	95	Highly Valid
Language Aspects	81	94	100	92	Highly Valid
Graphic Aspects	90	90	100	93	Highly Valid
Average Score	91	87	98	92	Highly Valid

Based on validation results by three validators in Table 5, an average percentage of 92% was retrieved on validity of the contents with category of highly valid.

The validity of content is used to determine the suitability of content and material developed in the teaching material with learning competencies and learning objectives (Hutama, 2016). The validity on material aspect, it obtained a percentage of 88% with category of highly valid. Android-based mobile learning module is following venture materials and simple aircraft whose indicators are adjusted to the indicators of critical thinking skill therefore the learning objectives to be achieved are improving critical thinking skills. This was also explained by Hendri et al. (2021), that valid digital modules must have basic competencies (KD) and subject matter with the development of clear learning objectives so that students can easily understand.

Presentation aspect retrieved an average percentage of 95% with category of highly valid. Validation on presentation aspects is used to evaluate the design of teaching materials developed so that the teaching materials have their characteristics (Hutama, 2016). The characteristic of an android-based mobile learning module is an application-shaped module with integrated use of digital tools and sources making teaching materials have advantages that are expected to repair student's critical thinking skills. Meanwhile, at graphing aspect, it obtained an average percentage of 93% with category of highly valid. Graphic aspect on module is inseparable from the suitability of the cover layout, color composition, graphics, layout, and synchronous visuals as well as layer design that must be considered (Febriyanti & Ain, 2021).

Language aspect obtained an average percentage of 92% with category of highly valid. Language validation to evaluate the language applied to write of teaching materials so that they have a good level of readability are communicative, and according to the rules, can make it easier for students to understand the content on teaching materials (Ridlo et al., 2020).

Based on this description, development of android-based mobile learning module teaching materials is declared valid because it has met the feasibility of content and constructs so that android-based mobile learning modules are worthy of being used as science teaching materials. This is following the research of Sa'diyah (2021), which stated that digital-based e-modules show validation results that are included in the category of valid and theoretically feasible. In addition, research by Purnamasari et al. (2020), also mentioned that development of valid android-based interactive e-modules can facilitate students to learn independently and is an innovative learning resource.

Table 6. Product Practicality Results

Aspects	Meeting to- (%)					Percentage	Category
Activities	1	2	3	4	5	Average (%)	
ıtroduction	92	90	95	98	98	95	Very Practical
ːore	92	93	93	94	93	94	Very Practical
ːover	98	96	100	100	100	98	Very Practical
Overall average	94	93	96	97	97	95	Very Practical

The results of observations in implementation of learning using an android-based mobile learning module showed that learning activities using android-based mobile-learning module in preliminary stage received a percentage of 95%, a core stage of 94%, and a closing stage of 98% so that it got a total percentage of 95%. This percentage shows that learning using android-based mobile-learning modules is highly valid. This is following the statement of Feriyanti (2019), the existence of e-modules is good for increasing the participation of students in learning process.

Android-based mobile learning modules are practically used in learning. These results are following the research of Wahyuni et al (2022) the results of practicality data analysis obtained a value of 95% which means android-based mobile-learning modules are included in highly practical category and can be operated in learning. Zukhrufurrohmah et al. (2017) stated that teaching materials are practical if the observation results show that the level of learning implementation is included in a high category and teaching materials developed can make it easier for teachers when teaching and easy to understand students.

Evaluation Stage

Evaluation stage is to provide an evaluation of effective products that have been developed. Data on the results of effectiveness were obtained through digital literacy tests and student response questionnaires. The elaboration Figure 7.

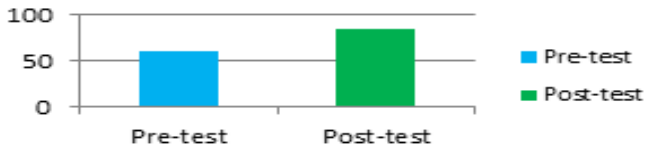

Figure 7. Average critical thinking ability test scores

Figure 7 displays the average results of a student's critical thinking skill test. Pretest gained an average of 60

while the posttest obtained 85.10. The average critical thinking skill test was then analyzed using N-gain test as follows.

Table 7. N-gain analysis results

Average		N-gain <g>	Category
Pretest	Posttest		
60	85.10	0.63	Medium

Based on Table 7, N-gain value reaches 0.63 which belongs to the medium category. Results of N-Gain analysis on any question indicator can be seen in Table 8.

Table 8. Results of analysis on indicators of critical thinking skill

Indicators	*N-gain*	Category
Interpretation	0.54	Medium
Analysis	0.46	Medium
Evaluation	0.59	Medium
Inference	0.55	Medium
Explanation	0.81	High
Self-regulation	0.5	Medium

Critical thinking skill indicator with the highest improvement result occurs in explanation indicator, while the lowest occurs in the analysis indicator. Research conducted by Ramdani et al. (2020), explained critical thinking skills indicators with excellent categories are found in explanation indicators, while the indicators with the lowest scores are analysis indicators, this is because questions with explanation indicators require more students' memory to provide appropriate information as explanations and reasons to answer questions correctly. Students who can explain the relationship between problem-solving concepts clearly and precisely can be said to have met the analysis indicators, while to meet the explanation indicators, students can provide reasons for conclusions drawn clearly and precisely (Purbonugroho et al., 2020).

The increase in students' critical thinking skills shows that android-based mobile-learning modules are effectively used in learning. The design of android based mobile-learning module is tailored to needs of students so that it can attract students to operate it. This is relevant to the research of Prianbogo & Rafida (2022) which concluded the development of android based electronic modules in form of codular applications as mobile learning are very feasible to be applied as a valid, practical, and effective learning medium. Gani et al. (2021), stated that android-based modules are highly practical to use and make it easier for students to study. A similar learn was conducted by Rismayanti et al. (2022), who stated codular based e-modules on androids are interesting and feasible to use and can repair the critical thinking skills of middle school students.

Table 9. Student Response Questionnaire Analysis Results

Indicators	Percentage (%)	Category
Interest	95.70	Very positive
Ease	94.34	Very positive
Satisfaction	96.48	Very positive
Average	95.51	Very positive

The results of questionnaire analysis student responses can be seen in Table 9, percentage reached 95.51%. This means that the response of students is very positive to android-based mobile learning modules. This happens because the products are developed to support the learning process by making learning more interesting, adding variety to learning, and making it easier for students to understand concepts (Rismayanti et al., 2022). Fun learning causes a very positive response from learners which has an impact on learning interests, classroom activities, and improved learning outcomes. Based on analysis of student response questionnaires, both in interest, response, interest, satisfaction, and motivation to get a very positive response so that android-based mobile learning modules are effectively used in learning process.

Conclusion

Android-based mobile learning modules get an average validity of 91.83% and belong to very valid category. The practicality obtained an average percentage of 95.48% and was included in very practical category. The effectiveness level is reviewed from N-gain score of critical thinking skill test and student response. The average N-gain of critical thinking skill tests was 0.63 with moderate categories. The average percentage of student response questionnaires was 95.91% with a very positive category. Based on this, android-based mobile learning modules are effectively used as teaching materials for science learning in middle schools.

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Author Contributions

Conceptualization, Lu'ailik.N. and Sri.W.; methodology, Lu'ailik.N.; software, Lu'ailik.N. and Zainur.R; validation, Sri.W. and Zainur.R.; formal analysis, Lu'ailik.N.; investigation, Lu'ailik.N.; resources, Lu'ailik.N.; data curation, Lu'ailik.N.; writing—original draft preparation, Lu'ailik.N.; writing—review and editing, Lu'ailik.N.; visualization, Lu'ailik.N.; supervision, Sri.W.; project administration,

Zainur.R. All authors have read and agreed to the published version of the manuscript

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The authors declare no conflict of interest.

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