



The Development of Learning Applications on Linear Equations Using A Contextual Approach

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Abstract

This research is motivated by limited learning media development to support students' learning processes. This research uses a contextual approach to test the validity and practicality of learning applications on linear equation material. The research method used is Research and Development (R&D), especially the 4D development model. To collect data, researchers used validation questionnaires distributed to experts in material, media, and language, as well as practicality instruments given to educators and students. The validation results show that the learning application on linear equation material using a contextual approach is very valid. The media expert assessment was 93.33%, the material expert assessment was 93.33%, and the language expert assessment was 92%. Then, the results of the practicality percentage obtained practical information with an assessment of the practicality of educators of 81.80% and an assessment of the practicality of students of 83.15%. Based on the overall data analysis results, the learning application developed is feasible and can be implemented in the learning process.

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Introduction

Education is organized to prepare students and society to face rapid developments, as well as to overcome increasing complexity and expand knowledge and the quality of education (Tanjung et al., 2022; Nurfatimah, Hasna, & Rostika, 2022). Mathematics teaching is a valuable lesson that can improve formal education environments (Novitasari, 2016). The development of critical, analytical, logical, creative, and systematic thinking abilities in individuals is greatly influenced by their involvement in mathematics learning. Schools must adapt the mathematics curriculum to suit students' abilities to ensure a practical learning experience (Sulistiani & Masrukan, 2016; Efendy, 2021). However, students often need help studying mathematics, and difficulties in learning mathematics due to a lack of understanding, disinterest, motivation, and inadequate teaching methods (Yeni, 2015; Syakur et al., 2021).

Based on interviews conducted with class VII mathematics teachers at SMP Negeri 6 Tanjungpinang, it is known that the school implements an independent curriculum. However, the effectiveness of implementing this curriculum's mathematics learning process could be more satisfactory. Not all students participate actively during the learning process; this can be caused by factors such as lack of focus, uninteresting subject matter, and low understanding of the material. Apart from that, it was found that linear equations are one of the materials that students need help understanding. Students need help understanding the information presented in the questions when presented with helpenarios that require the application of linear equations. As a result, they need help creating mathematical models and finding solutions to their problems. Interestingly, these difficulties align with the findings of research conducted by (Junita et al., 2019).

The interview findings revealed that the learning materials used in class were sourced from the Ministry. The teacher said that students face challenges in understanding the contents of these books because of the complexity of the language used, resulting in a lack of student interest. As a result, the books provided by the Ministry are rarely used as learning resources. Furthermore, observations made during mathematics learning show a traditional approach where the teacher is the center of attention in the learning process. The teaching methods used are lectures and discussions, with the teacher encouraging students to ask questions. However, many students still passively listen to the teacher's explanation without actively participating in the learning process. The only teaching tool used during lessons is the blackboard, which has limitations. According to (Oktavera, 2023; Putri & Izzati, 2023), limitations in utilizing diverse learning resources cause passive involvement of students and decreased interest in the learning process. As a result, this can hinder students' understanding of the material, ultimately impacting student learning outcomes.

A potential solution is to develop exciting and user-friendly learning materials to overcome the problems above. Learning media plays a vital role in teaching and learning activities, such as arousing enthusiasm and attracting students' attention during the learning process (Nurdyansyah, 2019). Yunita (2020) further explains that learning media functions as a communication tool, facilitating information delivery effectively and efficiently in a structured and conducive environment, ultimately leading to improved learning outcomes. Many studies have developed learning media

for learning mathematics (Wardani & Setyadi, 2020; Angriani, et al., 2020). However, they have yet to develop learning media in the form of learning applications with a contextual approach to the independent curriculum. In this research, the application is equipped with real-life settings, such as acquiring knowledge, understanding, learning in a group, applying knowledge, and reflecting knowledge. Learning applications can be accessed offline.

Learning media, driven by the rapid development of technology, is a catalyst for change in the educational sphere. Technology, such as computers, tablets, smartphones, cameras, and television, is harnessed as a learning medium, accessed and processed via electronic means (Bakhri, 2019; Batubara, 2021). In Arsyad (2016), it was revealed that smartphones, with their unlimited easy access, are a beacon of inspiration in learning media. Through smartphones, the learning media that can be developed are applications. These learning applications, with their ability to ignite students' motivation and enthusiasm for learning, also facilitate a deeper understanding of the learning material (Arini & Agustika, 2021).

In developing learning applications, it is essential to use teaching techniques that increase students' understanding of the content presented. As proposed by Mukhtar et al., (2022) the contextual approach is the most effective method for actively involving students in meaningful learning experiences. By connecting learning with real-life situations, contextual learning allows students to recognize the practicality of learning mathematics in everyday life (Mukhtar et al., 2022). This research aims to provide a comprehensive demonstration of both theory and practice regarding the development of learning applications on linear equations material using a contextual approach that is valid and practical.

Research Method

This research aims to develop a learning application on linear equation material using a contextual approach that is valid and practical. So, the type of research used is Research and Development (R&D). Research and Development, as stated by Rusinta et al., (2019), involves a systematic process of creating or perfecting software or hardware products, focusing on accountability. The research model used in this research is the 4D model. The stages in this research consist of the definition stage, including analysis of students' needs, material analysis, and formulating learning objectives; the design stage, which includes media design and instrument design; the development stage, which includes producing media in the form of applications, which experts then validate after it was declared valid, it was then tested on a large scale to test its practicality, and at the dissemination stage (Thiagarajan, 1974).

This research only reached the Development stage, namely testing validity and practicality by experts. The data collection method used is a questionnaire, and research instruments are media validation sheets, materials, language, and practicality instruments. The purpose of the validation instrument is to make it easier for researchers to determine the validity of learning applications. Experts first validated the instruments used. Apart from that, this research also uses two methods of data analysis. The first method, namely qualitative descriptive analysis, is valid for processing data sourced from suggestions and comments from experts. The second method is descriptive statistical analysis, useful for processing data obtained from

expert assessment scores in descriptive percentages. On the other hand, researchers also use data analysis or processing in the form of a Likert scale, which helps measure the level of suitability of a product being developed. The Likert scale has a formula for data processing which, according to Sugiyono (2017), is as follows:

$$(\%) = \frac{\text{score obtained}}{\text{maximum score}} \times 100\%$$

Researchers use an assessment criterion to determine whether the electronic learning media being developed is a valid and practical category level. The form of assessment criteria used by researchers is shown in the following Table 1 and 2.

Table 1. Likert Scale

Score	Criteria
5	Strongly Agree
4	Agree
3	Adequate
2	Disagree
1	Strongly Disagree

Table 2. Validity Criteria

Score	Criteria
$80\% < x < 100\%$	Very Valid
$60\% < x < 80\%$	Valid
$40\% < x < 60\%$	Valid Enough
$20\% < x < 40\%$	Less Valid
$0\% < x < 20\%$	Invalid

(Riduwan and Akdon, 2013)

Result and Discussion

This research results in a learning application of linear equation material centered on a contextual approach. This research uses a 4D model consisting of several stages: Definition, Design, Development, and Dissemination. From this research, the following data were obtained:

1. Definition Stage

At this stage, researchers analyze students' needs, analyze the material, and formulate learning objectives.

a. Analysis of Student Needs

At this stage, the process includes student identification, conducted through interviews with mathematics teachers at SMP Negeri 6 Tanjungpinang. In addition, observations were made, and questionnaires were distributed to collect information from students. Through interviews, observations, and distributing questionnaires, data was obtained showing that the education system in schools is still traditional, with a teacher-centered learning process approach. As a result, many students continue to take a passive role in their education, only focusing on listening to the

teacher's explanations. The teaching materials used mainly consist of textbooks provided by the ministry.

Based on this, researchers consider it necessary to develop learning applications as an alternative teaching material that can be accessed anytime and anywhere and helps students understand the material and practice working on questions independently so that learning becomes more effective. Electronic learning media can also make it easier for teachers to prepare and facilitate student activities in the learning process.

b. Material Analysis

During the material analysis, it was discovered that class VII junior high school students were using Mathematics books provided by the Ministry of Education and Culture. The material discussed in this book includes Integers, Algebra, Linear Equations, Comparison of Values and Inverse Comparison of Values, Building Spaces, and Presentation of Data. Through interviews conducted with class VII mathematics teachers, it was revealed that students face challenges when applying linear equations in real life. In particular, they have difficulty understanding the information provided in the problem, building mathematical models, and finding solutions to problems. Therefore, the researcher decided to include Linear Equations in the learning application to overcome these obstacles and increase students' understanding of the subject matter.

c. Formulating Learning Objectives

After the researcher decided to develop teaching materials in learning applications and chose Linear Equation material, the researcher determined the existing Learning Outcomes (CP) and Learning Objectives (TP) to help researchers develop products in the form of learning application teaching materials. Meanwhile, SMP Negeri 6 Tanjungpinang for class VII 4 uses the Independent Curriculum.

Table 3. Learning Achievements and Objectives for Class VII SMP Linear Equations Material

Learning Achievements (CP)	Material Scope	Learning Objectives (TP)
At the end of phase D, students can solve linear equations in one variable.	Equality Linear One Variable	Create a mathematical model that deals with linear equations in one variable and determines the solution set Solving everyday problems using the concept of linear equations Variable

2. Design Stage

This stage involves adapting the results of the material analysis that was carried out previously. There are two different stages at this stage: media design and instrument design.

a. Media Design

1) Selection of media format

The developed contextual approach-based electronic learning media produces an application with an .apk extension that can be accessed via Android devices. The content format in learning applications uses several media, namely text and images. Various media can attract students' attention to linear equation material. The pages contained in electronic learning media consist of the cover or front page, instructions for use, introduction, materials, evaluation, and author profile.

2) **Designing electronic learning media based on a contextual approach**

At the stage of creating the learning application, it is adjusted to the design stages that have been mapped previously. The following are the steps in designing a learning application.

- a) Design a learning application using the Canva application.
- b) Creating learning applications using Articulate Storyline 3 and Website 2 APK Builder Pro.
- c) Preparation of electronic learning applications based on document sources and textbooks.
- d) Determining the title of the electronic learning application is Class VII Linear Equations
- e) Develop a structure for the learning application.

b. Instrument Design

The instrument consists of several statements with a Likert Scale assessment. The instruments used to validate the data consisted of material validation sheet instruments, media validation sheet instruments, language validation sheet instruments, and practicality instruments. A lecturer will then validate the validation instrument. Mathematics education lecturers have mastery of all the fields that will be measured. The aim is to measure the validity and suitability of the instruments researchers will use.

As per the validator's expert assessment, the instrument validation sheet has been deemed valid. The validator's conclusions and suggestions have been meticulously considered, ensuring that the statements in the questionnaire are indeed capable of measuring the learning media being developed. The material instrument validation sheet scored 83% in the valid category, media scored 83% in the valid category, language scored 83% in the valid category, and the practicality questionnaire scored 84% in the valid category. This comprehensive validation process confirms the instrument's reliability and its suitability for use as an expert assessment tool in research data collection.

3. Development Design

The development stage aims to produce teaching materials in the form of learning applications. This media underwent a thorough revision process by experts and was tested for practicality by users. The following Figure 1, 2, and 3 are a display of learning application products using a contextual approach:



Figure 1. Display User Identity and Main Menu in The Learning Application



Figure 2. Display Instructions for Use, Study Instructions and Learning Objectives



Figure 3. Media Display based on Contextual Approach Characteristics

After the learning application on linear equation material using a contextual approach has been developed, the next step is to validate the product by validating media, material, and language experts. The next stage is a practicality test to ensure the product's suitability.

a. Validation

Validation is a technique to determine the feasibility of the learning application product being developed. At this stage, validation tests are carried out by material experts, media experts, and language experts. Product validation assessments use material, media, and language validation questionnaires.

1) Material Validation

The material expert validation assessment was carried out by three validators, including one UMRAH Mathematics Education lecturer, one mathematics subject

teacher at SMP Negeri 6 Tanjungpinang, and one mathematics subject teacher at Budhi Mulia Kundur Vocational School. The experts were given a material validation questionnaire sheet that assessed the content's appropriateness and the contextual approach's characteristics.

The material expert validation assessment results obtained a percentage of 93.33% with very valid criteria. Validity is reflected in the assessments of validator 1, validator two, and 3, almost all of whom stated that they agree and strongly agree with the statements on the material expert validation sheet based on several aspects. This is seen from the percentage of aspects, which include the appropriateness aspect of the content, 95%, and the characteristic aspect of the contextual approach, 91%. In this case, it means that the presentation of material in the learning application contains clear learning objectives. This is in line with research by [Astri et al., \(2022\)](#) namely that it is essential to consider the suitability between learning media and the desired learning objectives to maximize the effectiveness of learning objectives. Appropriate presentation of accurate mathematical concepts plays a vital role in ensuring students understand the material correctly ([Wardani & Setyadi, 2020](#)), the appropriate presentation of appropriate mathematical concepts, clear explanations of practice questions, and accurate feedback all contribute to achieving this goal. Using high-quality learning materials to engage students in their learning activities is essential. [Suarjana et al., \(2017\)](#) advocate a contextual learning approach, highlighting student involvement's importance and encouraging them to actively explore, build connections, and apply their knowledge in real-world scenarios.

2) Media Validation

The media expert validation assessment was carried out by three validators consisting of one lecturer in mathematics education at UMRAH, one lecturer in Mathematics Education at the Abdurrahman State College of Religious Sciences (STAIN SAR) and one mathematics subject teacher at SMP Negeri 6 Tanjungpinang. The experts were given a media validation questionnaire which contained an assessment of media design aspects, image and color quality aspects as well as aspects of ease of use of learning media.

The results of the media expert validation assessment obtained a percentage of 93.33% with very valid criteria. Validity is reflected in the assessments of validator 1, validator 2 and validator 3, who almost all agreed and strongly agreed with the statements on the media expert validation sheet based on several aspects. This is seen from the percentage of aspects that include media design aspects, 91%; image and color quality aspects 91%; and 100% ease of use of learning media. In line with [Astri et al., \(2022\)](#) aspects of appearance, image and color quality as well as ease of use indicate a quality of teaching media.

3) Language Validation

The linguist validation assessment was carried out by three validators consisting of one mathematics subject teacher at SMP Negeri 6 Tanjungpinang, one Indonesian language subject teacher at Maitreyawira School Batam, and one mathematics subject teacher at Budhi Mulia Kundur Vocational School. The experts were given a language validation questionnaire sheet, which contained an assessment of readability aspects, aspects of conformity with Indonesian language rules, and aspects of term usage.

The results of the linguist validation assessment obtained a percentage of 92% with very valid criteria. Validity is reflected in the assessments of validator 1, validator 2, and validator 3, who almost all agreed and strongly agreed with the statements on the linguist's validation sheet based on aspects. This is seen from the percentage of aspects that include readability, namely 93%; aspect of conformity with the Indonesian language rules 90%; and aspects of term use 93%. In this case, the learning application product developed meets the criteria of being very valid with revision notes and is worth testing. According to the Ministry of National Education (2003), one of the preparations of teaching materials involves easy sequencing, clear cognitive structures, summaries, and the use of easy-to-understand language.

b. Practicality

Based on the validation results of the learning application, which has been said to be valid, its practicality can be tested. At the product practicality testing stage, the practitioners consisted of a Mathematics subject teacher and 30 students in class VII 4 of SMP Negeri 6 Tanjungpinang. At the practical testing stage, researchers conducted the first meeting, namely demonstrating and installing the learning application to students and educators.

Next, the researcher gave a practicality questionnaire, which contained an assessment of aspects of use, benefits, physical condition, user satisfaction, and content on the media to determine the responses of educators and students. After that, the researcher obtained the questionnaire data that had been given and obtained the results that the learning application development product was said to be practical with the educator response being 81.80% in the practical assessment category. The division of aspects includes the use aspect at 80%, the benefit aspect at 86.66%, aspects of physical condition at 80%, the user satisfaction aspect at 80%, and the media content aspect at 80%. Meanwhile, learning media is said to be practical, with student responses of 83.15%. It can be seen from the assessment of student responses that almost all of them agreed and strongly agreed with the statements on the student questionnaire sheet. This can also be seen from the percentage results of several aspects, namely the usage aspect of 82%; benefit aspect of 85.33%; aspects of physical condition amounted to 82.66%; the user satisfaction aspect was 80% and the media content aspect was 83.11%. [Astri et al., \(2022\)](#) believe that using learning media can provide direct/real learning experiences for students to foster students' learning motivation. Then, in line with research ([Yerizon et al., 2017](#)), the practicality of teaching materials can be determined by evaluating their ease of use and attractiveness.

Based on the criteria, the learning application using a contextual approach meets the very valid and practical criteria. This research is in line with [Nugrohro and Merliza, \(2023\)](#) that learning media that can be used as teaching materials for students is said to be appropriate if it meets the quality in terms of validity and practicality.

Conclusion

Emphasizing the practicality of the contextual approach, the research results confirm the effectiveness of the electronic learning application on linear equation material. This approach meets the valid and practical criteria, making contextual-based learning media a practical choice for implementation in learning. Based on the overall data analysis results, the learning application developed is feasible and can be implemented in the learning process.

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