Development of E-Module with *Contextual Teaching and Learning* (CTL) Approach on Three-Variable Linear Equation System (SPLTV) Material to Improve Thinking Ability Critical Student

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ABSTRACT

This research aims to developt an e-module using the contextual teaching and learning (CTL) approach to improve students critical thinking skills in system of linear equations three-variable (SPLTV) that is valid, practical, and effective. This research employs a Research and Development (R&D) design with the ADDIE model, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The instruments used in this study include validation sheets, teacher and student response questionnaires, lesson implementation and student activity observation sheets, and critical thinking tests. The subjects of this study were 20 tenth-grade students of MA MDIA Bontoala Makassar. Based on the results of the trial, it was found that (1) the validation results by the validator team were 4.17, categorized as valid because it was within the interval [interval range]. (2) The results of the practicality criteria obtained based on the teacher response questionnaire were 87.5% with a very positive category and the implementation of learning obtained a value of 1.79 with a fully implemented category, from both analysis results, the e-module meets the practical criteria. (3) The results of the effectiveness criteria obtained based on the student response questionnaire were 80% with a positive category, student activity obtained a value of 88% with a very good category, and the critical thinking skills test obtained an N-Gain score of 65% with a fairly effective category, so that the e-module meets the effectiveness criteria. Thus, it can be concluded that the e-module with a contextual teaching and learning (CTL) approach to three variable linear equation systems (SPLTV) material meets the criteria of validity, practicality, and effectiveness. Therefore, it can be concluded that this e-module is declared to be of good quality and can be applied in learning activities.

Keywords: E-Module, *Contextual Teaching and Learning* (CTL), Three-Variable Linear Equation System (SPLTV)

Paper presented at The 1st ICONETT on August 21st-22nd, 2024
Faculty of Teacher Training and Education
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1) INTRODUCTION

Education is one of the most important aspects of human life. Quality education is essential to produce intelligent individuals who can compete in the global era. Education plays a very significant role in shaping character, developing knowledge and the mind of a child, who will eventually grow into an adult who will interact and do many things with their environment, both individually and as a social being (Sukmayasa et all., 2013). Therefore, education is very important for human life because education is one of the keys to improving human resources to be able to compete in this global era.

Mathematics is one of the most important sciences, both in everyday life and in the development of science and technology. Mathematics has the ability to be applied in various aspects, including technology. Since its early development, mathematics has been the foundation that supports technological advancements. In fact, mathematics is often referred to as the foundation of science due to its significant role. The importance of mathematics as a fundamental science is evident in the high demand for mathematical skills, especially in facing the challenges of the 21st century.

21st-century learning is expected to contribute significantly to the development of students' character who are ready to face the rapidly evolving global world. Therefore, successful 21st-century learning will produce students who possess the 4C skills: critical thinking, creative thinking, communication, and collaboration (Nahdi, 2019). One of the efforts that can be done to support 21st-century learning is to focus on critical thinking skills that can be developed through mathematics learning. The Indonesian Ministry of Education and Culture Regulation No. 81A of 2013 emphasizes the importance of students' critical thinking skills, which are necessary to become democratic, responsible, tolerant, and globally-minded citizens. However, students' critical thinking skills are still low and have not met expectations.

Based on observations and observations made at MA MDIA Bontoala Makassar, the facts of the problem were obtained; a) some students have difficulty in analyzing and solving problems contained in the mathematics problems presented so that students' cognitive ability in critical thinking is still low, b) teachers have never made e-modules, only using package books as the main teaching materials and *powerpoint* slides as a complementary medium, c) the teacher's teaching model in teaching is a conventional learning model using the lecture method.

To overcome these problems, it can be done by improving the learning process and making teaching material innovations as a means for students to improve their critical thinking skills. Teacher-centered learning methods need to be replaced with more active approaches, such as *contextual teaching and learning* (CTL). The *contextual teaching and learning* (CTL) approach is a learning process that helps teachers relate the material taught to real-world situations and encourages students to make connections between the knowledge they have and its application in daily life, which involves seven contextual components, namely constructivism, *questioning*, inquiry), *learning community*, *modelling*, *reflection* and *authentic assessment*. Presenting material with a contextual approach will make students know first hand the benefits of what they are learning (Trianto dalam Artikasari & Saefudin, 2017). When viewed from these seven main components of contextual learning, it is very synchronous with efforts to bring out students' critical thinking skills, especially in the components of questioning, finding, and reflecting (Nurlianti, 2020).

The innovation of teaching materials is used as a means for students to improve their critical thinking skills and can support student learning independently, namely with teaching materials in the form of modules. A module is a book written with the aim that students can learn independently without or with the guidance of a teacher (Ministry of National Education, 2008). Modules are a form of teaching materials that are packaged in a complete and systematic manner, which contains a set of learning experiences that are planned and designed to help students master specific learning objectives (Rahdiyanta, 2008). Along with technological advancements, printed learning modules can now be converted into an electronic format called e-modules. The e-module is designed as an interactive self-teaching material. By utilizing technology, e-modules can present learning materials in a more interesting and effective way, thereby helping students achieve the expected competencies.

Not only that, the selection of material content is really considered and adjusted to the characteristics of critical thinking skills so that the material of the Three-Variable Linear Equation System (SPLTV) was chosen as the focus of research for several reasons, namely (1) this material is very close to daily life and is easy to convert into the form of mathematical problems, (2) SPLTV has a variety of solution methods, (3) this material can be associated with various aspects of life, so that it allows the preparation of more interesting questions.

Regarding the research conducted, some of the previous studies were Turnip & Karyono (2021) has also conducted research that reveals that the use of e-modules as teaching materials has received

a positive response and is feasible to be applied in learning. Then the research conducted by Shanti, dkk. (2018) indicates that the *contextual teaching and learning* (CTL) is able to improve critical thinking skills when applied in mathematics learning. Furthermore, research from Presentation, DK. (2018) revealed that the results of the average score of improving students' critical thinking skills before and after using the module with the equation *Gain* normalized values of 0.50 were obtained with the criteria of *Gain* normalized medium category which means that there is an increase in students' critical thinking skills after using contextual-based modules.

Therefore, the development of e-modules with *a contextual teaching and learning* (CTL) approach on three-variable linear equation system (SPLTV) material to improve students' critical thinking skills needs to be developed with the aim of producing valid, practical and effective e-modules.

2) METHOD

The research employed in this study is Research and Development (R&D). R&D is a research methodology aimed at developing a specific product and subsequently evaluating its validity, practicality, and effectiveness. The research adhered to the ADDIE development model, which encompasses five sequential phases: Analysis, Design, Development, Implementation, and Evaluation.

This research was conducted starting from January 18, 2024. In this study, the subjects were 10th-grade students of MA MDIA Bontoala Makassar. The instruments used to collect data were a validation sheet, student and teacher response sheets, an observation sheet for learning implementation, an observation sheet for student activities, and a critical thinking skills test.

The validation sheet instrument was used to obtain data on the quality of the e-module and the created instrument devices. This validation sheet consists of a material expert validation sheet, a media expert validation sheet, a learning implementation validation sheet, a teacher response questionnaire validation sheet, a student response questionnaire validation sheet, a student activity validation sheet, and a critical thinking skills test validation sheet. The results of the validator assessment were then analyzed using data analysis from Hobri (2009), which is:

a) Recapitulating the results of expert assessments into tables: Aspects (Ai), assessment criteria (Ii), and the value of each validator (Vij).
b) Find the average of the assessment results of all validators for each criterion with the formula:

$$\overline{I_i} = \frac{\sum_{j=1}^{n} V_{ij}}{n}$$

Information:

$\overline{I_i}$: Average-i

V_{ij} : Data on the value of the j validator against the i-th criterion

n : Number of validators

c) Finding the average value of each aspect with the formula

$$\overline{A_i} = \frac{\sum_{j=1}^{n} \overline{K_{ij}}}{n}$$

Description:

$\overline{A_i}$: Average Aspec for-i

$\overline{K_{ij}}$: Average for the ith aspect by the jth assessor

n : The number of criteria in the i aspect

d) Finding the total average with the formula:

$$\overline{Va} = \frac{\sum_{j=1}^{n} \overline{A_i}}{n}$$

Description:

$\overline{Va}$: Average

$\overline{A_i}$: Average grade for the i-th aspect

n : Many aspects

e) Determine the validity of each criterion or averaging of aspects

E-module teaching materials with an approach *contextual teaching and learning* (CTL) in the material of the three-variable linear equation system (SPLTV) is said to be valid if it is at least in the valid category, namely if the value is in the interval of $4 \leq \text{Va} < 5$, meaning that if it is below 4, it means that revisions must be made.

The practicality of the e-module was assessed through teacher feedback and observations of its implementation. To be considered practical, the e-module had to receive at least a 'fairly positive' rating from teachers and demonstrate a 'fairly good' level of implementation. The effectiveness of the

e-module was evaluated based on three aspects: student responses, student activities, and student critical thinking skills.

3) RESULTS AND DISCUSSION

The development of an e-module using a contextual teaching and learning (CTL) approach for the material on systems of three linear equations (SPLTV) has been carried out using the ADDIE development model, which consists of five stages: analysis stage, design stage, development stage, implementation stage, and evaluation stage. The following is a further explanation of each stage of the ADDIE development in this research:

The first stage is the analysis stage. In this stage, the researcher identifies the problems faced by students. At this stage, the researcher conducts an analysis of several aspects, starting from the analysis of problems and materials obtained through observation and interviews, as well as the analysis of media creation applications. From observations and interviews conducted at MA MDIA Bontoala Makassar, it was found that the learning model used in teaching was a direct instruction model using the lecture method. The teaching materials used were grade 10 mathematics textbooks based on the Merdeka Curriculum. During the learning process, students tended to have difficulty understanding, trying, and solving problems in the presented mathematics problems, so students' cognitive abilities in mathematical critical thinking were still low, even though the teacher had used several media, such as books and PowerPoint slides displayed using an LCD. In addition, teachers more often taught using whiteboards and books during the learning process, resulting in a lack of optimization of school facilities and additional references for learning mathematics. Moreover, the school has adequate computer lab facilities and Wi-Fi and even uses an Android-based semester exam system, but has not yet utilized these technological facilities in the learning process, especially in mathematics. This information became supporting data for the researcher to choose to develop an e-module with a contextual teaching and learning (CTL) approach.

Following this, an in-depth analysis of the 10th-grade curriculum was conducted, and the topic of systems of three linear equations (SPLTV) was selected for the development of the e-module. Based on the analysis of various media creation applications, the iSpring Suite was chosen due to its suitability for the research needs. iSpring Suite was selected because of its user-friendliness, especially for beginners, and its ability to integrate various media types such as text, video, and images. Additionally,

the resulting e-modules can be accessed on Android devices. The interface of the iSpring Suite application can be seen in the following image.

Figure 1. *iSpring Suite*

The second stage is the design phase. This phase serves as a blueprint for the development of the learning materials in the subsequent development stage. This phase is also referred to as blueprinting or designing the framework (Ranta and Anismaya, 2017). The outcome of this phase is a blueprint of the model or module to be developed in the next stage (Mudjiran, 2021). During this phase, the researcher developed a concept map, designed the e-module structure, determined the visual design of the e-module, and the sequence of the content. Subsequently, the e-module was developed using the iSpring Suite application which is integrated with Microsoft PowerPoint. Furthermore, the researcher designed the research instruments, which included questionnaires, observation sheets for student and teacher activities, and critical thinking skills tests.

The subsequent stage is the development phase. The primary objective of this phase is to create and refine the learning media until it is ready for testing (Cahyadi, 2019). In this phase, the researcher developed an e-module based on the design developed in the preceding stage to be fully operational and installable on both Android devices and personal computers. This e-module is focused on the topic of systems of three linear equations (SPLTV) and is divided into two learning activities.

The development of the e-module using a contextual teaching and learning (CTL) approach commenced with designing all aspects of the cover and menus (home menu, user guide menu, and content menu), followed by organizing the content and preparing relevant images and learning videos. Subsequently, questions were created for skill enhancement, evaluation, and practice. Upon completion, all these components were integrated into iSpring Suite, a PowerPoint-based application, to form a cohesive e-module.

Upon completion of the e-module, the researcher developed instruments for data collection, including measures of practicality and effectiveness. Subsequently, a validation process was conducted by a panel of two experienced lecturers. The validation process involved two rounds, with revisions made based on the experts' feedback. Following these revisions, the e-module, developed using a

contextual teaching and learning (CTL) approach, along with the associated instruments, underwent a second round of validation. The assessment results provided by the validation panel are presented below:

Table 1 Description of the Validator Team Assessment Results

Research Instruments	Aspects	Valuation	Information
Material	Learning	4,00	Valid
	Fill	4,00	Valid
	CTL Components	4,00	Valid
	Average	**4**	**Valid**

Table 2 Results of Media Expert Validation

Validation Sheet	Indicator	Valuation	Information
Learning materials (e-module)	Display Aspects	4,00	Valid
	Programming Aspects	4,00	Valid
Average total validity of learning materials		**4**	**Valid**

As indicated in the two tables above, both the learning materials and the evaluation by media experts achieved a score of 4.00, falling within the valid category. Consequently, the e-module developed using a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV) is deemed suitable for piloting. The instruments employed in the e-module trial, including practicality instruments such as observation sheets of lesson implementation and teacher feedback questionnaires, were validated. Similarly, the effectiveness instruments, comprising student activity observations, student feedback questionnaires, and critical thinking skills tests, were also validated. Therefore, these instruments are deemed appropriate for use in the research.

The subsequent phase was the implementation stage. According to (Cahyadi, 2019), this phase is crucial to ascertain whether the objectives of developing the media have been met and to determine

if the developed e-module can effectively address the issues identified during the analysis stage. In this phase, the e-module, designed with a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV), along with the validated instruments, was piloted in a school setting. The trial was conducted at MA MDIA Bontoala involving 20 tenth-grade students over four meetings, comprising three learning sessions and culminating in a critical thinking skills assessment.

The implementation phase was also undertaken to assess the practicality and efficacy of the developed product. The practicality of the product was evaluated based on the analysis of observational data pertaining to the implementation of learning activities and the analysis of teacher feedback questionnaires. The ensuing analysis yielded the following results:

Table 3 Results of Learning Implementation Analysis

Aspects Observed	**Average Aspects of All Meetings**	**Information**
Preliminary Activities	1,89	Fully Implemented
Core Activities	1,75	Fully Implemented
Closing Activities	1,75	Fully Implemented
Average	**1,79**	**Fully Implemented**

The data analysis revealed an average score of 1.79 for the observation of lesson implementation, falling within the range of $1.5 \leq M \leq 2$, indicating that the lessons were fully implemented. Furthermore, the average percentage of positive responses from teachers was 87.5%, falling within the highly positive range of $85\% \leq RS \leq 100\%$. Consequently, the e-module developed using a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV) fulfills the criteria of practicality.

The efficacy of the product was assessed through the analysis of student engagement, student feedback questionnaires, and critical thinking assessments. The data analysis revealed that the average score for student engagement questionnaires was 88%, indicating a very high level of engagement. Furthermore, 80% of students provided positive feedback, and the results of the critical thinking assessment are presented below:

Table 1.4 Categories of Students' Critical Thinking Ability Results

Interpretation (%)	Category	*Pretest*		*Posttest*	
		Frequency	Percentage (%)	Frequency	Percentage (%)
$81{,}25 < X \leq 100$	Very High	0	0	6	30
$71{,}5 < X \leq 81{,}25$	Tall	0	0	6	30
$62{,}5 < X \leq 71{,}5$	Keep	0	0	3	15
$43{,}75 < X \leq 62{,}5$	Low	0	0	5	25
$0 < X \leq 43{,}75$	Very Low	20	100	0	0
Sum		20	100	20	100

The data analysis revealed that five students exhibited low levels of critical thinking, as evidenced by their post-test responses that only fulfilled one or two of the four critical thinking criteria. Three students demonstrated moderate levels of critical thinking, but their work lacked conclusions or inferences. Six students were classified as having high levels of critical thinking, although their work contained some errors in calculations, results, and conclusions. Finally, six students exhibited very high levels of critical thinking, providing accurate and comprehensive responses to all four critical thinking indicators. To assess the e-module's efficacy in enhancing critical thinking abilities, the subsequent N-Gain data analysis is presented:

Table 5 N-Gain Score Test Results

	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
N-Gain_Persen	20	65.7197	2.67338	11.95573
Valid N (listwise)	20			

Source: SPSS Data Processing, 2024

The analysis of N-Gain scores indicates an average score of 65.7197, or 65%, which falls within the category of moderate effectiveness. Consequently, it can be inferred that the e-module designed

using a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV) is moderately effective in enhancing students' critical thinking abilities.

The culminating phase of this development was the evaluation stage, aimed at identifying and addressing any shortcomings in the developed learning media. Subsequent to the implementation phase, further refinements were made based on the feedback received. However, no substantial modifications were made to the e-module designed with a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV). The following presents the visual representation of the e-module developed using the CTL approach for the topic of systems of three linear equations (SPLTV).

The preceding discussion leads to the conclusion that the e-module, which employs a contextual teaching and learning (CTL) approach to the topic of systems of three linear equations (SPLTV) within the instructional context, offers several critical considerations. Consequently, the e-module developed through the ADDIE model has successfully met the established criteria of validity, practicality, and effectiveness. Therefore, it can be asserted that the e-module, which utilizes a contextual teaching and learning (CTL) approach for the material of systems of three linear equations (SPLTV), is of sufficient quality for implementation in the learning process.

4). CONCLUSIONS

This study developed an e-module using a contextual teaching and learning (CTL) approach for the topic of Systems of Three Linear Equations (SPLTV), employing the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The e-module was declared valid with an average score of 4.17 based on the assessment by validators. The practicality analysis showed a very positive response from teachers (87.5%) and the implementation of the learning process was fully achieved (score of 1.79). The effectiveness of the e-module was measured by student activity (average score of 88%), student response (80%), and critical thinking skills test with an N-Gain score of 65%, which is categorized as fairly effective. Thus, the e-module with a contextual teaching and learning (CTL) approach for the topic of systems of three linear equations (SPLTV) is considered valid, practical, and effective for use by grade 10 students at MA MDIA Bontoala.

Acknowledgment

All praise is due to Allah, the Almighty, Who has granted me the strength and health to carry out and complete this research. I would like to express my gratitude to all members of MA MDIA Bontoala Makassar, especially the Headmaster, teachers, and students, for their support in conducting this research. I am also grateful to my supervisors who have continuously guided and provided me with direction and input throughout this research. Likewise, I would like to thank all lecturers at the State Islamic University Alauddin Makassar, especially all lecturers of the mathematics education study program.

REFERENCES

Artikasari, E. A., & Saefudin, A. A. (2017). *Menumbuh Kembangkan Kemampuan Berpikir Kreatif Matematis Dengan Pendekatan Contextual Teaching and Learning*. Jurnal Math Educator Nusantara, 3(2). https://doi.org/10.29407/jmen.v3i2.800

Cahyadi, R. A. H. (2019). *Pengembangan Bahan Ajar Berbasis Addie Model*. Halaqa: Islamic Education Journal, 3(1), 35–42. https://doi.org/10.21070/halaqa.v3i1.2124

Hernawan, A. H., Permasih, & Dewi, L. (2008). *Panduan Pengembangan Bahan Ajar*. Depdiknas Jakarta, 1–13.

Hobri. (2009). *Metodologi Penelitian Pengembangan (Aplikasi Pada Penelitian Pendidikan Matematika)*. PENA Salsabila.

Mudjiran. (2021). *Panduan Model ADDIE Untuk Penelitian R&D*. Journal of Chemical Information and Modeling, 53(February), 2021.

Nurlianti. (2020). *Peningkatan Kemampuan Berpikir Kritis Matematis Siswa Kelas X SMAN 1 Sentajo Raya Kuantan Singingi Melalui Model Pembelajaran Contextual Teaching and Learning (CTL) Univestitas Islam Riau*.

Prastuti, M. M. D., Sukarmin, & Aminah, N. S. (2018). *Pengembangan modul fisika berbasis kontekstual untuk meningkatkan kemampuan berpikir kritis dan kreativitas siswa pada materi kalor dan perpindahannya*. *7*(2), 168–181. https://doi.org/10.20961/inkuiri.v7i2.31680

Rahdiyanta, D. (2008). *Teknik Penyusunan Modul*. 1–14.

Shanti, W. N., Sholihah, D. A., & Abdullah, A. A. (2018). *Meningkatkan kemampuan berpikir kritis melalui ctl*. *5*(1), 98–110.

Sukmayasa, I. made H., Lasmawan, I. wayan, & Sariyasa. (2013). *Pengaruh Model Pembelajaran Kooperatif Tipe NHT Berbantuan Senam Otak terhadap Keaktifan dan Prestasi Belajar Matematika.* Journal Program Pascasarjana Universitas Pendidikan Ganesha, 3(1), 119–131.

Turnip, R. F., & Karyono, H. (2021). *Pengembangan E-modul Matematika Dalam Meningkatkan Keterampilan Berpikir Kritis. 9*(2), 485–498. https://doi.org/10.25273/jems.v9i2.11057