

Development of E-LKPD Based on *Realistic Mathematics Education* on Three-Variable Linear Equation System Material Oriented to Critical Thinking Skills and *Self-Efficacy* of Vocational School Students

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Abstract : This study aims to (1) describe the characteristics of e-LKPD based on realistic mathematics education on system of linear equations with three variables oriented towards critical thinking skills and self-efficacy of vocational school students, (2) describe the feasibility of e-LKPD based on realistic mathematics education on system of linear equations with three variables oriented towards critical thinking skills and self-efficacy of vocational school students in terms of validity, practicality and effectiveness. This type of research is research and development (Research and Development) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The research subjects were 34 students of class X TKP SMKN 2 Tarakan. In this research, One Group Pretest - Posttest Design was used. The research instruments used were validation sheets, practicality assessment sheets by teachers and students, learning implementation observation sheets, critical thinking ability tests and self-efficacy questionnaires. The results of the research show: (1) the e-LKPD developed contains characteristics found in the RME approach to the material of on system of linear equations with three variables oriented towards critical thinking skills and self-efficacy. The characteristics contained in RME-based e-LKPD include integrated learning, use of context, mathematization and construction processes and interactivity. (2) the RME-based e-LKPD developed meets the criteria for feasibility in terms of validity aspects with a percentage of feasibility according to material experts of 93.4% and media experts of 98.9% with the validation result criteria being very feasible; practicality with a very practical category based on the results of student and teacher responses; effectiveness based on critical thinking skills with classical completeness of students reaching 82.4%, the results of the T-test paired samples-test with a significance level of 5% obtained that there was an influence on students' critical thinking skills after treatment using RME-based e-LKPD, the N-Gain result was 0.73 with a high category, and the effectiveness of e-LKPD on self-efficacy with an increase in each self-efficacy indicator, the N-Gain result was 0.3 in the moderate category, and the results of the Wilcoxon test on self-efficacy data with a significance level of 5%, it was obtained that there was an influence on students' self-efficacy after treatment using RME-based e-LKPD.

Keywords: Development, E-LKPD, Realistic, Mathematics, Education.

1. INTRODUCTION

Based on Raudhah (2019) research, only a few students were involved in working on various follow-up questions and interview tests with data collection techniques that met the criteria for critical thinking, while other students only understood the literal meaning of the questions. This shows how little critical thinking instruction is given to children. Most learners are passive learners who have not actively added to their knowledge (Hirza et al., 2020).

Learning becomes more relevant and mathematical ideas can be fully understood when mathematics is applied to real-world problems, such as in the realistic approach to mathematics education (Astuti & Widianawati, 2016). In RME, learning must start from something real so that students can engage in the learning process in a meaningful way. The use of real context

in the learning process is in accordance with Zulkardi's opinion which states that the RME theory consists of 5 characteristics, one of which is the use of real context as a starting point in learning mathematics and relating various topics in mathematics, so it is hoped that learning with the RME module can guide students to relate concepts or theories in mathematics as a whole (Nufus, 2015).

Research by Nababan & Aminah (2017) revealed that the *realistic mathematics education* approach has several advantages that help improve students' critical thinking, such as facilitating understanding mathematical concepts, increasing students' interest and motivation in learning, and facilitating communication and collaboration between students. *Realistic mathematics education* is the right approach to using mathematics teaching with a curriculum that focuses on teaching higher-order thinking and helping to build students' problem-solving skills (Istriani & Suparman, 2019).

LKPD (Student Worksheet) is one of the learning tools that can be made by teachers as a learning tool that can be used for various learning purposes in the classroom. Currently, LKPD can be created electronically as a *softfile*, allowing for interactive learning in the classroom. LKPD, which is widely used in schools, only presents brief content and multiple-choice questions and essays, but is still not able to demonstrate the learning process in problem-solving with a learning approach that fosters critical thinking in students. One of the efforts to encourage students to ask questions in the form of stories is to relate them in their daily lives so that students can visualize the concept of the material (Pramudya et al., 2020).

The material of the three-variable linear equation system often poses challenges based on the researcher's observations and discussions with mathematics teachers at SMK Negeri 2 Tarakan. Many students have difficulty solving the problem of a three-variable linear equation system that is not exactly like the example given by the teacher. This shows the low critical thinking ability of students. In addition, the *self-efficacy* of students is also still low, as can be seen from the fact that there are still many students in class X who find it difficult to learn the material of the three-variable linear equation system, quickly give up and cheat on the answers of their friends who are considered smarter during the exam.

Based on this background, the researcher conducted a study with the title "Development of e-LKPD Based on *Realistic Mathematics Education* on Three-Variable Linear Equation System Material Oriented to Critical Thinking Ability and *Self Efficacy* of Vocational School Students".

2. LITERATURE REVIEW

Mathematics learning is a teaching and learning process that contains two types of activities that are inseparable. These activities are learning and teaching. These two aspects will collaborate in an integrated manner into an activity when there is interaction between students and teachers, between students and students and between students and the environment when mathematics learning is taking place (Ferdiansyah, 2017). According to Mujiono in (Sundayana, 2015) the mathematics teaching and learning process has four important components that affect the success of students' learning, namely learning materials, learning atmosphere, media and learning resources, and teachers as learning subjects. These components are very important in the learning process.

Realistic mathematics education is an approach in mathematics learning that was originally introduced and developed in the Netherlands in 1970 by Freudenthal (Ardiyani et al., 2018). This approach is based on Freudenthal's opinion that mathematics is a human activity (Wahyudi et al., 2017). This approach is also based on rational context problems to improve mathematical understanding (Dickinson & Hough, 2012). This is supported by the opinion of Sumirattana et al. (2017) that "*mathematics had to be connected to reality, stay close to children's experiences and be relevant to society*". Mathematics learning is applied through real events in life that are close to children's experiences that are relevant to society so that students can imagine.

e-LKPD based on *realistic mathematics education* is an electronic fill sheet that begins with the provision of contextual problems that will be solved by students so that students are able to find solutions to mathematical problems. e-LKPD based on RME has the potential to improve students' critical thinking skills because it emphasizes real problems that are directly connected to daily life (Melati, 2022).

LKPD (Student Worksheet) is a printed teaching material that must be worked on by students, in the form of collections of papers containing materials, essences, and instructions for the implementation of tasks that lead to the basic competition that must be achieved (Maimunah et al., 2019). The presentation of learning materials is not only from print media, but can also use digital media. One of the teaching materials that can be changed in electronic form is student worksheets. Electronic student worksheets (e-LKPD) are teaching materials that are systematically arranged in electronic form with animations, images, videos and others so that users become more interactive. e-LKPD can facilitate students in understanding learning

materials in electronic form that can be accessed using *computers, notebooks, laptops, smartphones* and mobile phones (Puspita & Dewi, 2021).

Snyder in (Amalia et al., 2019) revealed that critical thinking skills need to be learned in order to solve a problem, both easy and difficult in learning materials or in daily life. Critical thinking is an ability that directs a person to be precise in thinking and be able to determine something accurately. A person who has the ability to think critically can of course provide logical answers and arguments based on his knowledge. Krulik & Rudnick (1995) argue that critical thinking is a way of thinking that investigates, connects, includes gathering information, remembering, analyzing situations, understanding and identifying problems.

In Bandura's cognitive social theory, the term *self efficacy* is known which affects the choice of activity, a person's effort in completing the tasks they face. With regard to *self efficacy*, Bandura (Schunk et al., 2010) says that, "*Self efficacy is defined as, people judgments of their capabilities to organize and execute courses of action required to attain designates types of performances*". On the other hand, Santrock (2009) revealed that "*self efficacy is the belief that I am capable*". Bandura also said that high *self-efficacy* will make people work hard in carrying out their duties as best as possible. *Self efficacy* is the development of self-confidence in learning, where when students' *self-efficacy* is high, it can make the absorption process in learning better. *Self efficacy* affects student motivation, study habits, and achievement in academic subjects (Swe, 2022).

The three-variable linear equation system (SPLTV) is one of the material chapters that students of class X even semester learn in the independent curriculum. The content of the material studied in the chapter is the form of the three-variable linear equation system, solving the three-variable linear equation system by means (substitution, elimination, elimination and substitution), solving contextual problems related to the three-variable linear equation system, which includes creating mathematical models and solving the three-variable linear equation system. The purpose of studying SPLTV is that students can compile SPLTV from contextual problems and can solve contextual problems related to SPLTV (Education & Culture, 2014).

3. METHODS

This research is R&D (*Research & Development*) or research and development, with the research model used being the ADDIE model. ADDIE is a research model consisting of *Analysis, Design, Development, Implementation, and Evaluation* (ADDIE). The product developed in this study is e-LKPD based on *the realistic mathematics education approach* on the material of a three-variable linear equation system oriented to students' critical

thinking skills and *self-efficacy*.

The subject of the study was 34 students of class X Housing Construction Engineering 1 SMKN 2 Tarakan. The type of data produced from this study consists of quantitative data and qualitative data. Quantitative data in this study were obtained from the scores of the results of the e-LKPD validation by material experts and media experts, practical assessments from practitioners, student response questionnaires, observation sheets during the learning process, *pretest* and *posttest* critical thinking skills and *self-efficacy* questionnaires.

The techniques used in this study consist of test and non-test techniques. The test technique was carried out to obtain data on the effectiveness of the product, namely the students' critical thinking skills, then the non-test technique in the form of *a student self-efficacy* questionnaire to obtain effectiveness data

4. RESULTS

Validity data is analyzed with a formula and then interpreted with product feasibility criteria according to Arikunto (2013). e-LKPD and instruments are called valid if the validity results are at a value of more than or equal to 61% with the category of feasible or very feasible. Practicality data was obtained from a practicality questionnaire of teachers and students which was then interpreted with practicality criteria according to Masykur et al. (2017). e-LKPD is said to be practical if it is at a score of > 2.51 with the practical or very practical category. In addition, the effectiveness criteria are also reviewed from the implementation of learning, which is at least 85% implemented in the very good category.

The results of the *pretest* and *posttest* were analyzed with scoring guidelines with a maximum score for each student, which was 66 with a score of 100. The test used is in the form of a written test in the form of *an essay* with 3 questions. There were 34 samples of students in class X TKP 1 SMKN 2 Tarakan at the time of the *pretest* of critical thinking skills obtained the lowest score of 10 and the highest score of 58 with an average pretest of 39, while at the time of the *posttest* the lowest score of 62.5 and the highest score of 100 with an average score of 83.3, so that there was an increase in the average *pretest* and *posttest*.

5. DISCUSSION

The implementation of e-LKPD was carried out 4 *offline* or face-to-face meetings at school. Based on the results of the teacher's practicality questionnaire using the Likert 4 scale,

a total score of 64 was obtained from the maximum score of 64. The practicality value of e-LKPD is 4.00 and according to Masykur et al. (2017) it is in the very practical category. The results of the student practicality questionnaire using a scale 4 likert scale, the number of scores was 2005 from the maximum score of 2176. The practicality value of e-LKPD was obtained 3.69 and according to Masykur et al. (2017) it is in the very practical category. Practicality is also reviewed in terms of the implementation of learning activities by teachers. On average, each meeting, both in teacher activities and student activities, has a score of more than 81%, so it can be said to be very good. Based on the results of the interviews, the students' responses to e-LKPD varied.

The results of the RME-based e-LKPD data analysis met the effectiveness criteria. The critical thinking ability test was carried out with a total sample of 34 students who attended, the average *pretest* critical thinking ability was 39 and the average *posttest* critical thinking ability was 83.3, so there was an increase in the average *pretest* and *posttest*. This is reinforced with many students achieving KKTP at the end of learning with a percentage of 82.4% in the good category, this percentage has reached $\geq 80\%$.

The effectiveness of RME-based e-LKPD was reviewed from the *students' self-efficacy*, there was an increase in each self-efficacy indicator from before (*pretest*) to after (*posttest*) treatment. The *pretest self efficacy* score is 64, the *posttest self efficacy* score is 74.4 out of a maximum score of 100, then the *N-Gain* value is obtained at 0.3.

The improvement of critical thinking skills is inseparable from the influence of the use of RME-based e-LKPD developed. This is also strengthened by the results of research by Aprilianto & Sutarni (2023) that students' critical thinking skills can be built through the application of *realistic mathematics education* (RME). RME-based e-LKPD has the potential to improve students' critical thinking skills because it emphasizes real problems that are directly connected to daily life (Melati, 2022).

The increase in *self-efficacy* is also inseparable from the influence of the use of RME-based e-LKPD developed. e-LKPD provides interactive learning experiences, such as exercises, simulations, and learning videos. A study by Lee & Tsai (2019) shows that interactive learning experiences like this can strengthen students' *self-efficacy* in dealing with difficult material, because they can feel progress and success in mastering mathematical concepts. After implementing the developed RME-based e-LKPD, students' self-efficacy increased. This is also due to the existence of group activities that allow students to discuss and exchange ideas as they explore concepts.

6. CONCLUSION

The e-LKPD developed contains the characteristics contained in the *realistic mathematic education approach* on the material of a three-variable linear equation system oriented to critical thinking skills and *self-efficacy*. The characteristics contained in the e-LKPD that contain the characteristics of *realistic mathematic education* include integrated learning, the use of context, the process of mathematization and construction, and interactivity. The effectiveness based on mathematical critical thinking ability is seen from: 1) the classical completeness of students reaches 82.4% or more than 80% of students achieve the criteria for achieving learning objectives (KKTP), 2) The results of the t-test using *paired samples-test* on critical thinking ability data with a significance level of 5% are obtained that There was an influence on students' critical thinking skills after the treatment using e-LKPD based on *realistic mathematics education*, 3) The *N-Gain* result was 0.73 with a high category. The effectiveness of e-LKPD was reviewed from *the self-efficacy* of students obtained: 1) there was an increase in each self-efficacy indicator, 2) the *N-Gain result* was 0.3 in the medium category, and 3) the results of the *Wilcoxon test* on *self-efficacy data* with a significance level of 5%, it was obtained that there was an influence on *self-efficacy* students after treatment using e-LKPD.

LIMITATION

The e-LKPD developed can be accessed through researchers, Yogyakarta State University (UNY) and SMKN 2 Tarakan to be used in mathematics learning at the same level. The e-LKPD that has been tested is a three-variable linear equation system material. The results of this development are expected to be useful and socialized to educators through various discussion forums such as subject teacher deliberations (MGMP), technical guidance, seminars, workshops, and so on. e-LKPD based on *realistic mathematics education* is still very open to further development by educators both for other materials and other abilities that want to be improved. When developing applications using PPT and iSpring, researchers did not find a way to combine PPT macro functions. This results in feedback in the form of typing that cannot be done by students. The lack of tools in Ispring makes it difficult to equate the design in PPT with the design in Ispring, so we can only focus on developing our apk on one *software*, so that the apk we develop can be consistent in terms of design and appearance. The function of the tools in ppt cannot be used optimally.

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