

## Development of Mathematics E-LKPD with STEM Approach on Linear Program Materials

**Khusnul Khotimah<sup>1</sup>, Setia Dwi Arina<sup>2</sup>, Dian Kusuma Wardani<sup>3</sup>, Fitri Umardiyah<sup>4</sup>**

<sup>1</sup>Mathematics Education, Universitas KH. A. Wahab Hasbullah

<sup>2</sup>Mathematics Education, Universitas KH. A. Wahab Hasbullah

<sup>3</sup>Islamic Religious Education, Universitas KH. A. Wahab Hasbullah

<sup>4</sup>Mathematics Education, Universitas KH. A. Wahab Hasbullah

\*Email: [khusnulhotimah@unwaha.ac.id](mailto:khusnulhotimah@unwaha.ac.id)

---

### ABSTRACT

This research is a type of development research or R&D (Research and Development) which aims to determine the process and results of the development of E-LKPD mathematics with a science, technology, engineering, and mathematics (STEM) approach of linear program materials. The development model in this study uses the ADDIE model. Based on the results of the validity data analysis, according to the assessment of media experts, a percentage of 93.42% was obtained with a very valid category, and from material experts a percentage of 90.63% with a very valid category. The results of the students' responses increased the percentage to 85.86% with a very practical category. The results of the learning percentage obtained from the post test were 81% greater than the results of the learning percentage obtained from the results of the pre-test. Based on these data, it can be concluded that E-LKPD mathematics with a STEM approach for linear program materials is valid, effective and practical.

*Keywords: STEM, Mathematics; E-LKPD; Linear programs.*

---

### INTRODUCTION

Mathematics is one of the subjects learned from elementary school that is often considered difficult by students. Mathematics has an important role in daily life, meaning that mathematics is used in various areas of life. Mathematics has a significant impact on human life (Harahap et al., 2024). Mathematics can be interpreted as a science that is very influential in daily life, in an effort to become meaningful mathematics requires a problem-solving skill, including the process of understanding problems, planning, solving problems and solving problems in daily life (Ayu & Bouk, 2023). One of the materials that requires an understanding of concepts in solving problems in daily life is about linear programs (Gohae, 2023).

Linear programs are one of the materials to solve several obstacles, these obstacles include problems in various problem areas, for example problems in agriculture, economics, health and other daily problems that require a more detailed analysis (Elinda et al., 2023). According to Sunaryo, (2019) states that a linear program is a program/tool that is used through inequality as a method of determining the optimum value of a problem that has the purpose of finding the maximum value for the profit problem and the minimum value for the cost problem. According to Mitra & yeni (2023) stated that in mathematics learning, linear program material is included in the subject matter of learning taught at the SMK/SMA level, in solving linear program problems requires a high level of understanding and precision.

Problem-solving ability is the process of individuals in finding solutions or strategies related to the problems faced (Wijayanti et al., 2023). The weak mathematical problem-solving ability of students is also caused by the lack of understanding of students that mathematics learning materials are closely related to real life. As well as the lack of interaction between students and educators which leads to a lack of active participation of students in learning (Purnamayanti et al., 2023). To increase the active participation of students, a learning medium is needed.

Learning media is a technique in learning that can make it easier for educators to convey material to students (Rahmi & Samsudi, 2020). LKPD is a student learning media that contains a series of activities that will be carried out by students actively and guided by the basic competencies to be achieved (Izzah et al., 2023). In the era of the industrial revolution 4.0 where everything is controlled by technology, including in the world of education, it is proven that there are many technology-based learning media that make it easier for teachers (Firmadani, 2020). With that, there is a change in the LKPD from the printed version in gantikan to E-LKPD where student worksheets are digital with various features and can be accessed anywhere and anytime (Sumanik & Siregar, 2023). Electronic Student Worksheets (E-LKPD) are learning facilities that contain instructions, materials, sample questions, exercises to improve students' learning and skills with electronic media. E-LKPD (Electronic Student Worksheet) is an electronic teaching material and is a multimedia technology that presents information in a more concise and dynamic form (Khotimah et al., 2022). In addition to appropriate learning media to increase students' interest and creativity, it must be balanced with an appropriate learning approach.

Based on Government Regulation No. 19 of 2005 of the National Education Standard, the learning process in educational units is held in an interactive, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for initiative, creativity, and independence in accordance with students' talents, interests, and physical and psychological development (Sakdiah & Syahrani, 2022). Based on this, it is necessary to have a learning approach that can help students actively participate and provide enough space for creativity, and independence according to their talents and interests. media and learning approaches are an important component in education that plays a major role in determining the success of the educational process (Khotimah & Hasanah, 2021). An approach that fits this is the STEM approach.

The STEM approach is an approach that relates aspects of STEM, namely Science, Technology, Engineering, and Mathematics with the real life of students into the learning process (Mulyani, 2019). The application of STEM in learning activities consists of 4Cs, namely creativity, critical thinking, collaboration, and communication, so that students can find innovative solutions to the problems faced in real life and can convey them well (Wulandari, 2020).

Based on the results of interviews with mathematics teachers at SMK NU Al-Hidayah Ngimbang Lamongan, the researcher obtained the results that schools have not used learning media, only using textbooks, youtube links and through WhatsApp, due to the lack of knowledge of learning media and limited facilities, as well as the lack of students who think critically and creatively. In addition, the mathematics teacher stated that in general, students' understanding of problem solving and understanding of the concept of solving problems in daily life about determining the optimum score is still lacking, so that students are less active in learning.

Based on the above statement, the researcher will develop a digital-based learning media, which is in the form of an interesting and practical E LKPD on linear program material. This E-LKPD is prepared with a STEM approach. Therefore, this research was conducted with the title "Development of E-LKPD mathematics with a STEM (Science, Technology, Engineering, and Mathematics) approach for linear program materials.

The objectives of this research are (1) to find out the process of developing E-LKPD mathematics with a STEM approach for Vocational Linear Program Materials. (2) To find out the results of the Development of Mathematics E-LKPD with the STEM approach of Vocational Linear Program Materials.

## **METHOD**

This research uses a type of Research and Development (R&D) research. Research and Development is a research method used to produce a specific product, and test the effectiveness of that product (Satiti et al., 2021). This research aims to develop E-LKPD Mathematics with a STEM approach.

The media development model used is R&D (Research and Development) using ADDIE development with five stages, namely Analysis, Design, Development, Implementation and Evaluation. The ADDIE development model with 5 interrelated and systematically structured components means that the application from the first stage to the fifth stage must be systematic and not applied randomly (Satiti et al., 2021).

In the analysis stage, there are two stages, namely the needs analysis stage and the material analysis stage. Needs analysis aims to identify products according to the target. The researcher conducted interviews with mathematics teachers to find out the development of teaching materials and approaches to

mathematics learning. Based on these problems, researchers feel the need to develop a mathematics E-LKPD with a STEM approach. The analysis of the material aims to determine the material to be presented in the E-LKPD in accordance with the basic competency standards and learning objectives. The basic competencies in linear program material are explaining the two-variable Linear Program, the method of solving it with contextual problems and solving contextual problems related to two-variable linear programs.

At the design stage, the researcher designs the E-LKPD according to the data obtained from the analysis stage. The design process is carried out by designing an E-LKPD by paying attention to the structure of the material in the school. The structure of the E-LKPD consists of five components which include book covers, competencies to be achieved, materials, sample questions, and practice questions with a STEM approach. The material is designed and adjusted to the basic competencies to be achieved and the learning approach used, namely the Science, Technology, Engineering, and Mathematics (STEM) approach. Then the researcher determines the size of the E-LKPD, the design of the cover, the typeface and the color to be used. The cover design and E-LKPD material/content design are made using the canva application. Practice questions are made using the quizizz application. Furthermore, the researcher determines the appropriate assessment tools, namely the provision of pre-test and post test.

At the development stage, the researcher realized a product in the form of E-LKPD based on the problems that had been obtained from the analysis stage, prepared based on planning carried out at the design stage, and which had been revised several times based on the suggestions and criticisms of material experts and media experts.

At the implementation stage, the researcher realized a development product in the form of E-LKPD which had been declared feasible by media experts and material experts. The implementation of product in schools uses E-LKPD in the learning process. Students also get feedback in the form of student response questionnaires which are used to test the practicality of the product. Students were also given a test to measure learning outcomes used to measure the effectiveness of the E-LKPD.

In the Evaluation stage, the evaluation stage is the final stage in the development process carried out by the researcher. This evaluation was carried out based on the evaluation of the product developed through a response questionnaire given after the product was used in learning. This stage is carried out so that the products produced can become quality products and relevant to the needs of students.

## **RESULT AND DISCUSSION**

### **Result**

The results of this study aim to determine the process and results of the development of Electronic Student Worksheets (E-LKPD) with a STEM approach on linear program materials that are valid, practical, and effective. This research was conducted at SMK NU Al-Hidayah Ngimbang Lamongan to determine the validity, practicality and effectiveness of developing Electronic Student Worksheets (E-LKPD) with a STEM approach. The development model used in this study is the ADDIE development model which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation. Based on these stages, the following results were obtained:

#### a. Analysis stage

At the needs analysis stage based on interviews conducted with mathematics teachers, information was obtained that students considered mathematics lessons regarding material about problem solving in daily life to be difficult lessons and the lack of creativity of students in understanding material related to problem solving in daily life. In addition, in the learning process, the teacher who delivered the material with the lecture model was then continued by doing practice questions in the book used by the students. The lack of learning media makes learning feel boring for students. This causes students to be less active in learning.

Based on this, the researcher presents linear program material in class XI of SMK NU Al-Hidayah. The following are the Basic competencies and learning objectives.

**Table 1.** Basic Competencies and Learning Objectives

Basic Competencies	Learning Objectives
3.2 Explain the two-variable Linear Program and its solution method with the problem kontekstual	1. describe the concept of a two-variable linear system of equations and inequalities 2 determine the solution area of a two-variable linear inequality system

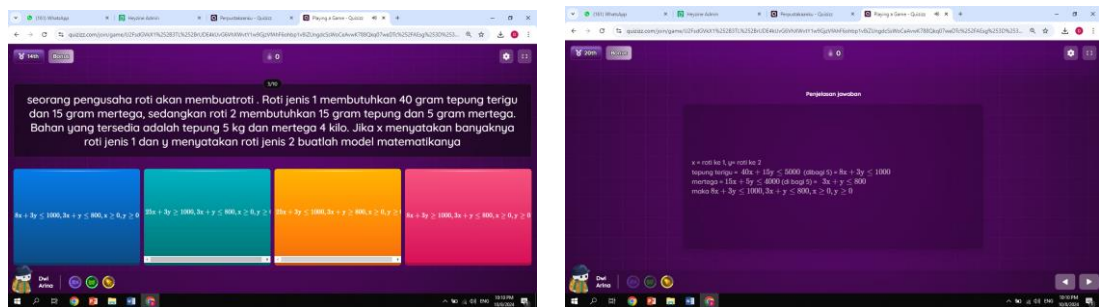
4.2 Solve contextual problems related to two-variable linear programs	1. Creating a mathematical model of problems related to linear programs 2. Determine the Linear Program Completion Area 3. Determining the optimal value
---	--

**b. Design Stage**

the design of the Electronic Student Worksheet (E-LKPD) in accordance with the data obtained from the analysis stage. The sections presented in this E-LKPD include: Cover, Core Competencies and Learning Objectives, content of E-LKPD with a STEM approach, Practice questions and tests. Examples of questions and practice questions provided are based on a STEM approach. The following is a view of the E-LKPD mathematics with a STEM approach to linear program materials.



**Figure 1.** E-LKPD Display



**Figure 2.** Practice Questions on Quizizz

The E-LKPD was compiled using the Hyzine Flipbook application, after the cover design process using the Canva application, followed by compiling STEM-based practice questions using quiziz and pre test and post test using google form.

**c. Implementation Stage**

After the design process, the development process was continued where E-LKPD with a STEM approach of linear program material was validated by 2 experts, namely media experts and material experts. The following are the validation results from media experts and material experts:

**Table 3.** Results of Media Expert Validation Data

Number	Validation assessment indicators	Validation value	Validation Categories
1.	Viewability aspects	100%	Highly Valid
2.	Eligibility aspects of ISI	88,64%	Highly Valid
3.	Language eligibility aspects	100%	Highly Valid
	Rata-rata	93,42%	Highly Valid

Based on the Table. 3 obtained the average percentage by media experts is 93.42% with a very valid category, so E-LKPD with a STEM approach of linear program materials can be used with a slight revision. The following are the results of material validation:

**Table 4.** Results of Material Expert Validation Data

Number	Validation assessment indicators	Validation value	Validation Categories
1.	Eligibility aspects of ISI	91,67%	Highly Valid
2.	Eligibility aspects of Practice Questions	85%	Highly Valid

3	Language and Display eligibility aspects	95%	Highly Valid
	Rata-rata	90,63%	Highly Valid

Based on Table 4, the average percentage by material experts was 90.63% with a very valid category. In the validity criteria of E-LKPD with a STEM approach, linear program materials can be used with slight revisions.

**d. Implementation Stage**

After being validated and revised, the product was tested on 20 students in class XI TKJ SMK NU Al-Hidayah Ngimbang Lamongan. The first meeting was used for introduction, filling out a pre-test to measure students' initial ability in linear program material. Then providing ice breaking along with motivation followed by explaining basic competencies and learning objectives. then create a group, each group consists of 5 students and then start to enter linear program materials using E-LKPD with a STEM approach. Then the explanation of the material and sample questions, students do engineering and do practice questions and so on.

**e. Evaluation Stage**

Evaluation is the final stage at this stage of development. At this stage of evaluation, the product is revised, revised in accordance with comments, suggestions from experts and students. All suggestions from experts and students regarding the improvement of the E-LKPD that has been developed have been well revised.

Based on the results of the pre-test of class XI TKJ students, it shows that they have not reached the completeness of the KKM score in the linear program material. The KKM score at Al-Hidayah Ngimbang vocational high school is 75. The following are the results of the student pre-test:

**Table 5. Student Pre-test**

Number	Number of students	Interval	Completeness Category
1	0 students	$\geq 75$	Complete
2	20 students	$< 75$	Incomplete
	Percentage of classical completeness	0%	Very Not Good

Based on table 5, the results of the pre-test students got an average of 0% classical completeness. With 0 students who completed and 20 students who did not complete. With a comparison between the criteria and the results showing classical completeness in the pre-test of linear program material, it shows a very poor category. After using E-LKPD, there was an increase in the percentage of classical completeness. The following are the results of the student's post test:

**Table 6. Post Test Results of Students**

Number	Number of students	Interval	Completeness Category
1	17 students	$\geq 75$	Complete
2	3 students	$< 75$	Incomplete
	Percentage of classical completeness	85%	Excellent

Based on table 6, the results of the post test students got an average classical completeness percentage of 85% with the very good category. With 17 students who completed and 3 students who did not complete the post test. With a comparison between the criteria and the results, the classical completeness in the pre-test of the linear program material shows a very good category. Furthermore, after using E-LKPD in learning, students are given a student response questionnaire. The following are the results of the student response questionnaire:

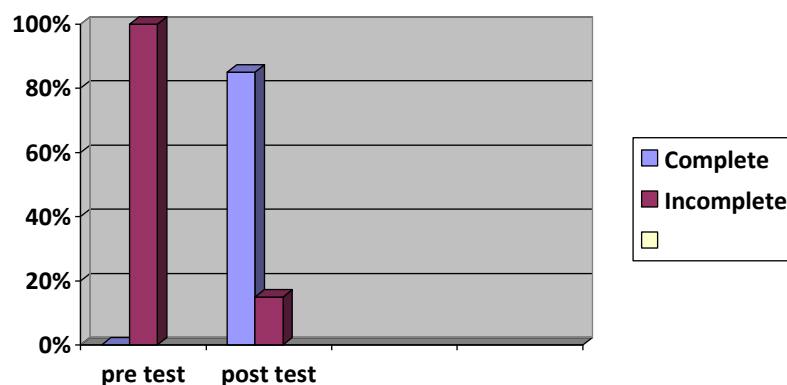
**Table 7. Results of Material Expert Validation Data**

Number	Validation assessment indicators	Validation value	Validation Categories
1.	Display Aspects	85,83%	Highly Valid
2	Material Aspects	88,25%	Highly Valid
3	Aspects of Interest	83,5%	Highly Valid
	Rata-rata	85,86%	Highly Valid

Based on table 7, it shows that the results of the student response questionnaire have an average percentage of 85.86% with a very practical category. The comparison between the criteria and the results shows the practical criteria.

### Discussion

Based on the results of the research, it can be seen that learning using E-LKPD mathematics with a STEM approach on linear program materials has high effectiveness in learning. This is shown by the difference in the results of classical learning completeness between pre test and post test of students.



**Figure 3.** Classical learning completeness diagram

Based on figure 3, it shows that in the post test, the completeness of classical learning obtained 85% with very good criteria, which is greater than the completeness of classical learning in the pre-test which obtained 0% with the category of very poor. Based on research at SMK NU Al – Hidayah Ngimbang Lamongan, the results of the STEM approach have a positive impact in accordance with the theory:

First, learning that uses the STEM approach in learning activities consists of the 4Cs, namely creativity, critical thinking, collaboration, and communication, so that students can find innovative solutions to the problems faced in real life and can convey them well (Wulandari, 2020). So that learning is easier to understand by students

Second, learning using the STEM approach has a positive impact on students' interest in learning and motivation. In the study (Davidi et al., 2021), it is stated that improving the quality of learning through the introduction of STEM education as a preventive approach is expected to help students integrate aspects of science, technology, engineering, and mathematics, as well as affect the development of students' reasoning skills. Until now, STEM education has proven to have a positive impact on students' performance, attitudes, learning interests, and motivation.

Third, mathematics learning using the STEM approach makes students not only understand mathematical concepts, but also have concepts about processes and technology and innovate through the engineering process. This is in accordance with the opinion (Puspitasari et al., 2021) stating that the STEM approach emphasizes four fields of science, namely science, technology, engineering, and mathematics, making students not only have an understanding of mathematical concepts, but also have an understanding of processes and technology as well as the ability to innovate through the Engineering process.

### CONCLUSIONS

Based on the research on the development of E-LKPD mathematics with a STEM approach, it can be concluded that: (1) the process of developing E-LKPD learning media with a STEM approach using the ADDIE model, there are 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation. (2) The results of the development of E-LKPD with a STEM approach of linear program materials meet the criteria of validity and are suitable for use according to the assessment of media experts (93.42%) with a very valid category, media experts (90.63%) with a very valid category. Based on this, E-LKPD with a STEM approach is declared feasible to be used in learning. The use of E-LKPD

with a STEM approach is considered practical for learning, this is evidenced by the results of the student response questionnaire which obtained 85.86% with a very practical category, which can be concluded that students are helped by the existence of learning media. The use of E-LKPD with the developed STEM approach is effectively used in learning. This is shown by the percentage of learning obtained from the results of the post test after learning using E-LKPD with a STEM approach (81%) is greater than the percentage of learning completeness obtained from the results of the pre-test using E-LKPD with a STEM approach (0%), which can be concluded that E-LKPD is effective in helping students in learning.

## REFERENCES

- Ayu, M. P., & Bouk, Y. M. (2023). Analisis kemampuan pemecahan masalah siswa kelas xi ipa pada materi program linier di man waikabubak. *Jurnal Pendidikan Matematika (JPM)*, 9(1), 93-102.
- Davidi, E. I. N., Sennen, E., & Supardi, K. (2021). Integrasi pendekatan stem (science, technology, enggeenering and mathematic) untuk peningkatan keterampilan berpikir kritis siswa sekolah dasar. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, 11(1), 11–22. <https://doi.org/10.24246/j.js.2021.v11.i1.p11-22>
- Elinda, E., Laelasari, L., & Raharjo, J. F. (2023). Analisis computational thinking dalam menyelesaikan masalah pada materi program linear. *Prisma*, 12(1), 115. <https://doi.org/10.35194/jp.v12i1.2635>
- Firmadani, F. (2020). Media pembelajaran berbasis teknologi sebagai inovasi pembelajaran era revolusi industri 4.0. *Konferensi Pendidikan Nasional*, 2(1), 93–97.
- Gohae, N. K. W. (2023). Pengembangan modul pembelajaran program linear. *FAGURU: Jurnal Ilmiah Mahasiswa Keguruan*, 2(1).
- Harahap, A. R., Ananda, D. P., Daulay, P. I., & Zulham. (2024). Sejarah peradaban islam dalam perkembangan matematika. *Bhinneka: Jurnal Bintang Pendidikan Dan Bahasa*, 2(1), 173–179.
- Izzah, S. M., Nabhar, N., & Auliya, F. (2023). Pengembangan e-lkpd berbasis pendekatan kontekstual menggunakan liveworksheets pada materi bangun ruang sisi datar kelas viii. *Jurnal Pendidikan Dan Keguruan*, 1(9), 763–774.
- Khotimah, K., & Hasanah, F. (2021). Penerapan media bandicam dengan pendekatan realistik untuk meningkatkan hasil belajar siswa pada pelajaran pai kelas xi ips di sma negeri plandaan jombang. *JoEMS (Journal of Education and Management Studies)*, 4(4), 29–36. <https://doi.org/10.32764/joems.v4i4.533>
- Khotimah, K., Istinganah, S., Umardiyah, F., & Nasrulloh, M. F. (2022). Pengembangan e-lkpd matematika berbasis hots pada materi bangun ruang prisma dan limas smp kelas viii. *JoEMS (Journal of Education and Management Studies)*, 5(5), 48–57. <https://doi.org/10.32764/joems.v5i5.799>
- Mulyani, T. (2019). Pendekatan pembelajaran stem untuk menghadapi revolusi. *Seminar Nasional Pascasarjana 2019*, 7(1), 455.
- Purnamayanti, I. G. A., Suharta, I. G. P., & Astawa, I. W. P. (2023). Pengembangan E-LKPD Interaktif Berorientasi PMRI untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa SMP Kelas IX. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(3), 3147–3158. <https://doi.org/10.31004/cendekia.v7i3.2884>
- Puspitasari, E., Dwi Aristya Putra, P., & Handayani, R. D. (2021). Pengembangan Buku Ajar Fisika Berbasis Science, Technology, Engineering, and Mathematics (STEM) pada Pokok Bahasan Suhu dan Kalor di SMA. *Jurnal Literasi Pendidikan Fisika (JLPF)*, 2(1), 44–52. <https://doi.org/10.30872/jlpf.v2i1.465>
- Rahmi, M. N., & Samsudi, M. A. (2020). Pemanfaatan media pembelajaran berbasis teknologi sesuai dengan karakteristik gaya belajar. *Edumaspul: Jurnal Pendidikan*, 4(2), 355–363. <https://doi.org/10.33487/edumaspul.v4i2.439>
- Sakdiah, H., & Syahrani. (2022). Pengembangan standar isi dan standar proses dalam pendidikan guna meningkatkan mutu pembelajaran di sekolah. *Cross-Border*, 5(1), 622–632.

- Satiti, W. S., Lathifah, A., & Nasrulloh, M. F. (2021). Soal model PISA konten space & shape untuk menunjang kemampuan berpikir matematis peserta didik. *Journal Of Education and Management Studies*, 4(4), 43–48.
- Sumanik, N. B., & Siregar, L. F. (2023). Pelatihan Pembuatan e-lkpd melalui liveworsheets dan canva di smpn 3 merauke. *Jubaedah : Jurnal Pengabdian Dan Edukasi Sekolah*, 3(1), 14–24.
- Sunaryo, A. (2019). Penggunaan media pembelajaran geogebra terhadap hasil belajar siswa tentang materi program linier kelas X. *Journal on Education*, 2(1), 96-103.
- Wijayanti, N. S., Maulana, M., & Isrok'atun, I. (2023). Kemampuan pemecahan masalah peserta didik dalam pendekatan comprehensive mathematics instruction. *JNPM (Jurnal Nasional Pendidikan Matematika)*, 7(1), 55. <https://doi.org/10.33603/jnpm.v7i1.7610>
- Wulandari, L. (2020). Penerapan pendekatan steam berbasis proyek “pendopo joglo” untuk meningkatkan keterampilan 4c kelas viii. *JPK: Jurnal Profesi Keguruan*, 6(2), 146–154.