

DEVELOPMENT OF *E-LKPD* MATHEMATICS PROJECT-BASED LEARNING TO INCREASE THE CREATIVITY OF JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

This study aims to develop a mathematics learning media in the form of an electronic student worksheet (E-LKPD) based on the Project-Based Learning (PjBL) model to enhance the creativity of junior high school students. The research employed the Research and Development (R&D) method using a modified 4D development model up to the development stage. The research subjects were 20 seventh-grade students of SMP Muhammadiyah 1 Tuban. The instruments included validation sheets by experts, student response questionnaires, observation sheets for lesson implementation, as well as pre-tests and post-tests. The validation results showed that the subject matter expert gave a score of 81% (very valid), the media expert 80% (valid), and the test item validation 87% (very valid). Practicality was indicated by lesson implementation observations of 92.1% and student responses of 86.6%, both categorized as very practical. The effectiveness test using the N-gain resulted in a score of 0.547, which falls into the medium category. Therefore, the developed E-LKPD is valid, practical, and effective in improving students' creativity.

Keywords: *creativity; E-LKPD; mathematics laboratory; media development; project-based learning.*

ABSTRACT

Penelitian ini bertujuan untuk mengembangkan media pembelajaran berupa E-LKPD Matematika berbasis model Project Based Learning (PjBL) untuk meningkatkan kreativitas siswa SMP. Penelitian ini menggunakan metode Research and Development (R&D) dengan model pengembangan 4D yang dimodifikasi hingga tahap pengembangan. Subjek penelitian adalah 20 siswa kelas VIII SMP Muhammadiyah 1 Tuban. Instrumen yang digunakan antara lain lembar validasi media oleh para ahli, kuesioner respon siswa, lembar observasi pelaksanaan pembelajaran, serta pre-test dan post-test. Hasil validasi ahli materi menunjukkan persentase validitas 81% (sangat valid), ahli media 80% (valid), dan validasi soal tes 87% (sangat valid). Kepraktisan media ditunjukkan dari pengamatan pembelajaran sebesar 92,1% dan kuesioner respon siswa sebesar 86,6% yang masuk dalam kategori sangat praktis. Hasil uji efektivitas menggunakan N-gain memperoleh skor 0,547 yang masuk dalam kategori medium. Dengan demikian, media E-LKPD yang dikembangkan valid, praktis, dan efektif dalam meningkatkan kreativitas mahasiswa.

Kata kunci: E-LKPD; kreativitas; matematika; pembelajaran berbasis proyek; pengembangan media



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Introduction

In this era of globalization, the world of education faces challenges in the form of rapid and complex technological developments. It demands the development of 21st-century skills, including creativity, collaboration, communication, and critical thinking. One of the efforts to overcome these

challenges is to utilize technology in learning (Edhana, 2019). According to Resti et al.(2024), the use of technology can provide many benefits, both for students and teachers. For students, technology can increase learning motivation, independence, and creative thinking skills. Meanwhile, for teachers, technology helps to present learning materials more efficiently, interestingly, and interactively (Aulia et al., 2025).

In the context of the Independent Curriculum, teachers are encouraged to be active facilitators in student-centered learning. The curriculum emphasizes the importance of meaningful and contextual learning and encourages students to think creatively and innovatively (Diva Agita Purva, 2025). One learning model that aligns with this approach is Project-Based Learning (PjBL), which provides a learning experience through the completion of real-life projects. Through this model, students have the opportunity to be actively involved, collaborate, and produce works, so that their creativity can develop optimally (Nusfiyah, 2024).

However, based on observations and interviews with teachers at SMP Muhammadiyah 1 Tuban, it was found that the learning process is still dominated by lecture methods and the use of printed textbooks without optimal technology integration. The material is delivered conventionally, while the available teaching materials are not yet able to stimulate students' creativity. This condition has an impact on low active participation and creativity (Nurfadhillah et al., 2021). In fact, creativity is one of the important indicators in achieving 21st century competence(Dimas Saputra, Vindi Isna Maulidah, 2025). Guilford (1950)and Torrance (1974) defines creativity as the ability to think differently that includes fluency, flexibility, originality, and elaboration. Munandar (2009) adding that sensitivity to problems is also an important part of creativity. Thus, creative students are expected to be able to find new solutions, dare to try different things, and produce original products from their learning experiences.

To overcome these problems, it is necessary to develop technology-based teaching materials in the form of E-LKPD that are integrated with the Project Based Learning (PjBL) model. E-LKPD enables digital, interactive, and engaging delivery of materials, while providing a space for students to explore ideas, work in teams, and create products from projects they are working on (Hamidah & Mastroah, 2025). According to Zhalila & Medical (2024) Technology-based teaching materials designed with an active learning approach have been proven to significantly increase students' interest and understanding. Based on theoretical basis and empirical conditions in the field, the researcher is interested in conducting a research entitled "Development of Project Based Learning Based Mathematics E-LKPD to Increase the Creativity of Junior High School Students." The developed E-LKPD is expected to be able to create effective, interesting, and appropriate learning for junior high school students in the digital era. To ensure its quality, E-LKPD will go through the stages of validity, practicality, and effectiveness testing before being widely implemented.

One possible solution is to develop technology-based teaching materials in the form of e-LKPD (Electronic Student Worksheets) that are integrated with the Project-Based Learning (PjBL) model. E-LKPD allows for digital, interactive, and more engaging delivery of materials (Alexander Mahombar, 2025). In addition, e-LKPD provides more space for students to explore ideas, work in teams, and create

products from their projects. According to Zhalila and Medika (2024) Technology-based teaching materials designed with an active learning approach can significantly increase students' interest and understanding.

Several previous studies have also shown that the implementation of PjBL has a positive effect on student creativity (Nurhikmah & I, 2022; Suprihatin, et. al., 2025). Similarly, the development of interactive e-LKPD has been shown to increase motivation and learning outcomes (Sari, L., & Wibowo, 2023). However, this study generally focuses on aspects of learning motivation or cognitive outcomes, and has not specifically examined the influence of PjBL-based e-LKPD on the development of students' creativity, especially in mathematics at the junior high school level. Thus, there is a research gap that can be filled by developing a PjBL-based Mathematics e-LKPD to increase student creativity.

Based on theoretical foundations and empirical conditions in the field, the researcher is interested in conducting a research entitled "Development of Project-Based Learning-Based Mathematics E-LKPD to Increase Creativity in Junior High School Students." The e-LKPD developed is expected to create effective, engaging learning that is in line with the needs and characteristics of junior high school students in the digital era. To ensure its quality, E-LKPD will undergo validity, practicality, and effectiveness testing before being widely implemented.

Theoretically, this research is expected to enrich the treasury of educational science, especially in the development of technology-based teaching materials that are in line with the Independent Curriculum and oriented towards increasing student creativity. Practically, this research is useful for: (1) teachers, as an alternative innovative learning media that supports active and creative learning; (2) students, to increase participation, motivation, and creativity in solving mathematical problems; (3) schools, as an effort to improve the quality of learning and the quality of graduates; and (4) other researchers, as a reference and foundation for similar research in the future.

Research Methods

This research uses research and development (R&D) methods. According to Sugiyono (2019) . R&D is a research method that produces a product and tests its effectiveness. The development model used is a 4D model developed by Thiagarajan et al., (1974), which consists of the stages of definition, design, development, and deployment. However, in this study, researchers only reached the development stage because the research focused on limited trials of the product being developed. The data obtained is analyzed as a reference for making products according to school needs, then developed and evaluated (Sugiharti, et.al. 2025).

The limited trial design in this study is the Pre-Test and Post-Test Design of One Group, with 20 eighth grade students of SMP Muhammadiyah 1 Tuban as subjects. The sampling technique used was total sampling, because the number of eighth grade students was relatively small so that all students were involved as research subjects (Asrulla et al., 2023).

The characteristics of the research subjects were 20 students, 10 males and 10 females. Based on preliminary data (previous semester report card scores), the average academic ability of students is 68, with a classical completion rate of 45%.

This data shows that most students are still below the Minimum Completion Criteria (KKM).

The instruments in this study include: (1) media validation sheets by material experts and media experts, (2) validation sheets for pre-test and post-test questions, (3) observation sheets for the implementation of learning activities, (4) student response questionnaires, and (5) student learning outcomes. In this development research, the validation sheet of the mathematics e-module was utilized to obtain assessment data from material expert lecturers, media expert lecturers, and educators as input for evaluating the developed mathematics e-module (Arjoni, et.al. 2025). Quantitative data on the validity and practicality of the media were analyzed using a scale *Likert Usfiyana* (Mendrofa et al., 2024) shown in Table 1.

Table 1. Likert scale

Information	Score
Very Bad	1
Bad	2
Pretty good	3
Good	4
Very good	5

Source: Usfiyana (Mendrofa et al., 2024)

Table 1 is used to measure the level of validity and practicality of media with a range of 1 to 5.

Quantitative data on practicality from the observation of product implementation was analyzed with a guttman scale according to Ridwan (Aziz, 2019) shown in Table 2.

Table 2. Skala guttman

Answer	Score
Yes	1
Not	0

Table 2 is used to measure the level of media practicality of the server through observation of the implementation of the developed media product.

Next, the value of each criterion is recapitulated using the Arikunto formula (Khairunnisa et al., 2023) that is:

$$Persentase = \frac{\text{Total Assessment Score}}{\text{Maximum Assessment Score}} 100\%$$

The data that has been recapitulated is then criteria according to the criteria that have been set. Table 3 shows the validity value criteria of the developed media.

Table 3. Validity criteria

Percentage	Criterion
0%-20%	Cancel
21%-40%	Less Valid

41%-60%	Quite Valid
61%-80%	Legitimate
81%-100%	Highly Valid

Based on Table 3, it is obtained that the developed media is said to be valid if > 60%. Table 4 shows the value criteria of the practicality of the developed media.

Table 4. Practicality criteria

Percentage	Criterion
0%-20%	Practical
21%-40%	Less Practical
41%-60%	Quite Practical
61%-80%	Practical
81%-100%	Very Practical

Based on Table 4, it is obtained that the developed media is said to be practical if > 60%.

To measure the effectiveness of media in improving learning outcomes, N-gain analysis was carried out (Kolopita et al., 2022). With the following formula:

$$N - Gain = \frac{Skor\ Post\ test - Skor\ Pre\ test}{Skor\ Ideal - Skor\ Pre\ test}$$

Information:

Pre-test score = Student's score before studying

Post-test score = Student's score after study

Ideal score = Maximum score

The category of effectiveness of N-Gain is shown in Table 5.

Table 5. N-Gain category

N-Gain	Criterion
$g < 0,3$	Low
$0,3 \leq g \leq 0,7$	Keep
$g > 0,7$	Tall

Source: Hake dalam (Kumawati, 2023)

This N-Gain analysis serves to measure the extent to which students' learning outcomes improve after using the developed media (Yulia Hasan, Susilawati, 2025). The media is said to be effective if the N-Gain score is in the medium or high category, indicating that the developed media is able to provide a significant improvement in the understanding of students' material.

Results and Discussion

The results of the development research that has been carried out are as follows:

Determine the Level

At the initial analysis stage (definition), the researcher identified the need as the basis for the development of E-LKPD Mathematics media based on Project Based Learning (PjBL). This analysis includes the curriculum, the condition of student

learning outcomes, problems in learning, and the reasons for choosing the material to be developed.

SMP Muhammadiyah 1 Tuban uses the Independent Curriculum with an allocation of 8 hours of Mathematics learning time in grade VIII which is divided into 4 meetings of 40 minutes each lasting 40 minutes per JP. The Minimum Completeness Criteria (KKM) for Mathematics subjects is set at 73.

Based on daily test data in one of the classes, an average score of 39 was obtained, which is far below the KKM. Of the 32 students, only 12 students (37.5%) have completed it, while 20 students (62.5%) have not yet achieved graduation. This condition shows that the majority of students still have difficulty in understanding Mathematics material.

The results of observations and interviews with teachers also reinforce these findings. Students tend to be passive in the learning process because the methods used by teachers are still dominated by lectures and routine exercises without involving creative activities. In addition, students have difficulty understanding material that requires spatial visualization skills, especially building spaces. Many students are still confused by the difference between the type of building space and the difficulty in calculating volume and surface area. The teaching materials used are also less interesting because they are still in the form of conventional printed worksheets that are not interactive.

Spatial building materials (cubes and blocks) were chosen in this study because based on the analysis of daily repetition results, the topic was one of the materials with the lowest score. This material requires high visualization skills and spatial thinking skills, which have been obstacles for students. In addition, building space materials are very relevant to be applied in the Project Based Learning model, because they can be associated with real project activities, for example making models of cubes and blocks from simple materials, calculating the volume and surface area, and connecting them to problems in daily life.

With these conditions, the development of interactive learning media in the form of Project-Based Learning-based E-LKPD is very important. This media is expected to make students more active through project activities, help students visualize the concept of building space, and improve learning outcomes through a more contextual and meaningful learning process.

Design Stage

In the design stage, the researcher prepared an initial framework for Project Based Learning (PjBL) based E-LKPD Mathematics media by considering media selection, format, and product design. This media is developed in the form of an interactive website using Canva as the main platform. Canva was chosen because it provides attractive visual features, supports multimedia integration of text, images, videos, and interactive links, and is easily accessible on both smartphones and computers. With these advantages, Canva is expected to improve media interactivity while making it easier for students to access learning.

To enrich the learning experience, this media is also equipped with supporting platforms, namely YouTube as a learning video provider, Google Form as a quiz tool that allows automatic assessment, and Quizalize as an interactive question practice medium with direct feedback. The selection of this supporting

platform is based on academic considerations so that learning is more active, varied, and in accordance with the characteristics of digital generation students. The structure of the E-LKPD media developed consists of: Starting Page, Table of Contents, Identity, Introduction, Learning Outcomes, Learning Objectives, Achievement Indicators, PjBL Syntax, Instructions for Using LKPD, Concept Map, Learning Materials, LKPD and Interactive Games, Reflections, and Bibliography. The implementation of the PjBL syntax is systematically integrated into the E-LKPD. At the beginning with the important question phase, students are directed to solve contextual problems surrounding building spaces. Furthermore, the design of a plan for the project phase is facilitated through the LKPD which guides students to draw up a plan to make a cube or block model. The phase of creating and developing products is carried out by creating real models, while currently the product phase is carried out through presentations or documentation of project results. Finally, the evaluation phase is carried out through reflection, quizzes, and interactive question exercises. To clarify the media design, the researcher also compiled a storyboard containing the visual design of the page, menu layout, and integration of multimedia elements, so that the learning flow in E-LKPD can be visualized in a more concrete way.

The following are some views of the learning media developed. Figure 1 shows the cover or front page while Figure 2 contains learning outcomes.

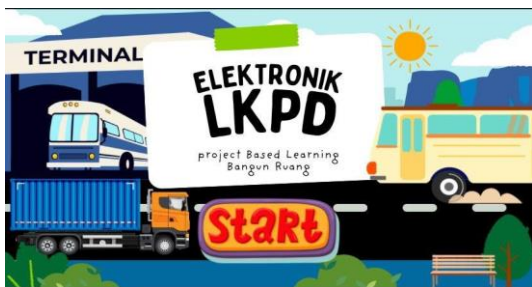


Figure 1. Cover

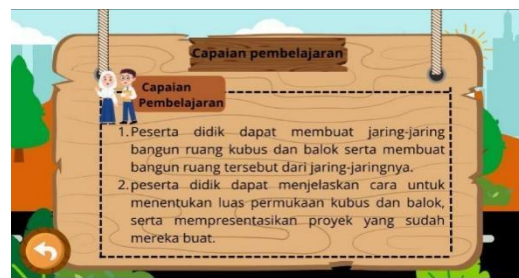


Figure 2. Content of learning outcomes

Development Stage

The development stage is carried out through three main activities, namely media validation, limited trials, and media effectiveness analysis. Media validation is carried out to determine the level of product validity before implementation. This validation includes three aspects, namely learning materials, learning media, and test instruments (pre-test and post-test). Each aspect is assessed using a Likert scale with a score range of 1–5 on some assessment items, and then the result of the validator's score is calculated using the percentage formula:

$$\text{presentase kevalidan} = \frac{\text{jumlah skor yang diperoleh}}{\text{skor maksimal}} \times 100\%$$

The validation results showed that the material aspect obtained a percentage of 81% (very valid), the media aspect 80% (valid), and the test instrument 87% (very valid). Feedback from validators shows the need to improve language redaction to make it simpler and adjust the visual look to be more consistent. In general, the validation results state that the media is worth testing with minor revisions.

Limited trials were carried out to assess the practicality of the media through observation sheets for learning implementation and student response questionnaires. The observation sheet was assessed using the Guttman scale (yes = 1, no = 0) with an average implementation percentage of 92.1% (very practical). The data of the student response questionnaire was analyzed using the Likert scale, with a practicality percentage of 86.6% (very practical). Further analysis showed that the language aspect obtained the highest score (89%), which signifies that students feel the language used is clear and easy to understand. On the other hand, the aspect of mentoring (83.5%) is the lowest, so there needs to be additional supporting features, such as more varied sample questions, to help students understand the material more optimally.

The effectiveness of the media was analyzed using pre-test and post-test scores calculated using the N-Gain formula:

$$N - Gain = \frac{(skor\ post - test) - (skor\ pre - test)}{(skor\ ideal) - (skor\ pre - test)}$$

The results of the analysis showed that the total pre-test score of 586 from 2000 (average 29.3) increased to 1360 from 2000 (average 68) on the post-test. The N-Gain value of 0.547 belongs to the medium category. This shows that PjBL-based E-LKPD media is able to significantly improve student learning outcomes, although there is still room for improvement.

The revision obtained from the media expert validator is that the display of the media displayed is made more attractive.

Figure 3 shows the appearance of the learning media before the revision.

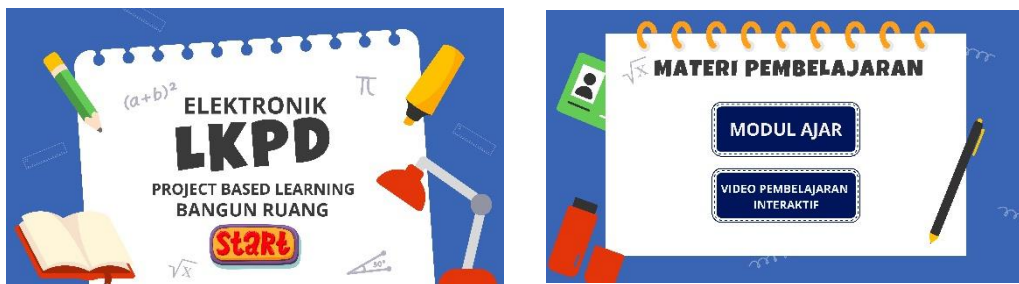


Figure 3. Views Before Revision

Figure 4 shows the learning media after being revised.



Figure 4. Post-revision view

When compared to previous research, the results of this study are relatively in line. For example Mandopa (2024) found an increase in creativity with an average validity of 3.28 (scale of 4), practicality of 3.5, and completeness of 89.65%. Research by (Febrian & Verdi, 2023) also showed an increase in learning outcomes with an N-Gain of 0.66, while STEP, (2023) reported validity of 81.35% and practicality of 83.35%. The difference in this study lies in the use of Canva as the main platform in the form of an interactive website, which was relatively rarely used in previous studies and provides wider accessibility through students' smartphones. The novelty of this study is the integration of Canva with supporting platforms such as YouTube, Google Form, and Quizalize in one project-oriented learning medium. However, this study has some limitations. The research subjects involved only one class so the results could not be generalized widely. Media implementation was also limited to four meetings, making it impossible to assess the long-term impact on student creativity. In addition, this study only focuses on cognitive learning outcomes, not touching affective and psychomotor aspects in depth. Therefore, advanced research is recommended to involve more subjects, longer duration of implementation, and more comprehensive analysis in the realm of students' attitudes and skills.

Conclusions And Suggestions

Based on the results of research and development, the E-LKPD Mathematics media based on Project Based Learning (PjBL) was declared feasible to use. The validation results showed that the media obtained a validity percentage of 81% from material experts (very valid), 80% from media experts (valid), and 87% from test instruments (very valid). The practicality test also obtained very practical results, with a percentage of 92.1% in implementation observation and 86.6% in student responses. The effectiveness test resulted in an N-Gain score of 0.547 (medium category). Thus, this media is valid, practical, and effective enough to be used in learning Mathematics, especially in building materials, and has the potential to increase student creativity.

Further research is recommended to develop the medium to the dissemination stage, involve a wider range of trial subjects, and use different materials or levels of education. Visual design and integration with other learning platforms can also be improved to make it more engaging. In addition, Mathematics teachers can consider the use of PjBL-based E-LKPD as an alternative learning medium to support students' creativity in the classroom.

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