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# DEVELOPMENT OF INTERACTIVE MULTIMEDIA-BASED STUDENT WORKSHEETS (LKS) TO FOSTER STUDENTS' MATHEMATICAL CREATIVE THINKING SKILLS

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**Abstrak**

Tujuan dari penelitian ini adalah untuk menghasilkan Lembar Kerja Siswa (LKS) Berbasis Multimedia Interaktif Untuk Menumbuhkembangkan Kemampuan Berpikir Kreatif Matematis Siswa yang valid dan praktis. Penelitian ini merupakan penelitian dan pengembangan dengan menggunakan model ADDIE terdiri dari *analisys* (kurikulum, siswa dan materi), *design, development, implementation* dan *evaluation*. Penelitian ini menggunakan instrumen lembar validasi perangkat pembelajaran dan lembar kepraktisan didapatkan dari lembar respon siswa. Penelitian ini dilaksanakan di SMA N 6 Kota Bengkulu kelas X tahun ajaran 2024/2025 dengan materi Baris dan deret aritmatika. Dari hasil penelitian didapatkan bahwa LKS berbasis multi media interaktif untuk menumbuhkan kemampuan berpikir kreatif matematis valid dan praktis. Hasil validasi LKS berbasis multi media interaktif menunjukkan kreteria sangat layak untuk hasil validasi ahli materi dengan rata-rata skor 3,61 dan hasil validasi media dengan rata-rata skor 3,67 termasuk kategori sangat layak. Kepraktisan LKS berbasis multi media interaktif yang dikembangkan diperoleh dari penilaian praktis dari siswa. Hasil analisis angket respon siswa diperoleh skor sebesar 78,3% sehinga LKS berbasis multi media interaktif dinyatakan dalam kategori sangat praktis.

**Kata kunci**: LKS Berbasis Multi Media Interaktif, Kemampuan Berpikir Kreatif Matematis Siswa, Model Pengembangan ADDIE

**Abstract**

*This study aims to develop a valid and practical Interactive Multimedia-Based Student Worksheet (LKS) to foster students' mathematical creative thinking skills. The research adopts a development research design using the ADDIE model, which includes the stages of Analysis (curriculum, students, and learning material), Design, Development, Implementation, and Evaluation. Instruments used in this study consist of validation sheets for learning tools and student response questionnaires for measuring practicality. The research was conducted at SMA Negeri 6 Bengkulu City with Grade X students during the 2024/2025 academic year, focusing on the topic of arithmetic sequences and series. The results demonstrate that the developed interactive multimedia-based LKS is both valid and practical. Expert validation results indicate that the material aspect achieved an average score of 3.61 and the media aspect achieved 3.67, both categorized as "highly appropriate." In terms of practicality, analysis of student response questionnaires yielded a score of 78.3%, which also falls into the "highly practical" category. These findings suggest that the developed LKS is a feasible and effective tool for enhancing students' mathematical creative thinking skills in secondary education settings.*

***Keywords:*** *Interactive Multimedia-Based Student Worksheet (LKS), CreativeThinking, ADDIE Development Model*

## INTRODUCTION

The rapid advancement of science and technology has greatly impacted education, particularly through the integration of computer-based technologies. This shift requires teachers to innovate their instructional methods and keep up with technological trends to deliver more engaging and effective learning experiences,

especially through instructional media. However, a lack of digital-based teaching materials often results in decreased student interest, lower reading literacy, and monotonous classroom activities. This is supported by (Kasmayanti et al., 2023) , who highlight that the scarcity of digital instructional materials contributes to learning difficulties and reduced student engagement.

The dynamic shifts in curriculum—from the Competency-Based Curriculum (KBK) to the School-Based Curriculum (KTSP), followed by the 2013 Curriculum, and now the Merdeka Curriculum—are adjustments made in response to the rapid advancement of science and technology (Saputro & Akila, 2025). These changes require teachers to continuously develop and implement technology-based instructional media. The integration of multimedia in the learning process aims to support more engaging instructional goals and contributes positively to student learning outcomes (Tasril, 2022). This is further supported by findings from (Wulandari et al., 2025), who reported that the use of interactive e-modules significantly enhanced student engagement, as evidenced by increased participation and enthusiasm during learning sessions. The analysis of N-Gain scores revealed a substantial improvement in comprehension: 65% of students demonstrated a moderate increase, 30% showed a high increase, and only 5% exhibited a low improvement. According to (Lestari et al., 2021), the developed interactive learning multimedia can align with the school curriculum and is engaging for students. The learning process is designed with two-way communication as an aspect of interactivity and structured in accordance with the intended learning objectives.

One example of an instructional media innovation that utilizes technology is interactive multimedia learning media. The use of interactive media in the learning process is an instructional innovation that helps motivate students and promotes their active involvement (Dewi & Wijayanti, 2025). One promising innovation is interactive multimedia learning media, which combines text, color, graphics, animation, audio, and video to create dynamic and engaging presentations (Kasmayanti et al., 2023). Interactive multimedia shifts the teacher's role from being the sole knowledge source to a facilitator, encouraging active student participation. According to a study cited by (Nopriyanti, 2015), people retain up to 80% of learning content when they see, hear, and do simultaneously, highlighting the effectiveness of multimedia tools in learning.

Further, (Ningrum et al., 2023) emphasize that digital interactive teaching materials accessible via smartphones and laptops enhance students' understanding by presenting content through videos, images, and audio. (Sutikno, 2013) also notes the significant influence of ICT on educational values and the widespread adoption of ICT-integrated learning.

In mathematics education, fostering students' creative thinking is crucial and requires active involvement in concept formation. The lack of varied instructional media can hinder the development of higher-order thinking skills, including mathematical creative thinking. (Ristontowi & Riwayati, 2020) define mathematical creative thinking as the ability to find new, flexible, and acceptable solutions to problems, which helps students solve problems independently and better understand complex concepts.

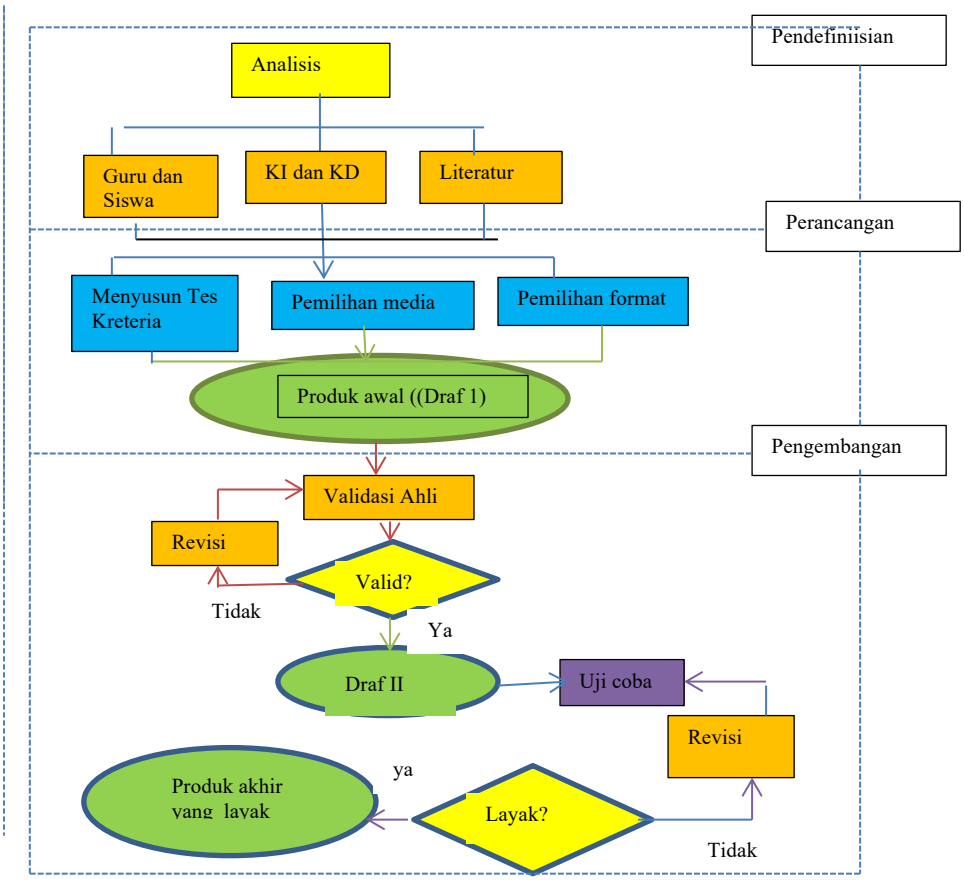
According to (Riwayati Selvi, Relawati, 2022), mathematical creative thinking ability is the output of mathematical creativity, while creative activities refer to instructional practices designed to stimulate or foster students' creativity. The appropriateness in selecting instructional media is one of the key factors that determine the success of developing students' mathematical creative thinking skills.

Interactive multimedia-based student worksheets (LKS) present a promising medium to support these skills. According to (Novaliyosi et al., 2022), interactive worksheets facilitate higher-order thinking and align well with technological advancements. (Sopani et al., 2024) LKS as creative, technology-integrated learning tools that engage students through visual and interactive content. This is supported by (Rachmawati et al., 2020), who found that interactive web-based media effectively improve students' mathematical creative thinking. Based on this strong foundation, the

present study aims to develop a valid and practical interactive multimedia-based student worksheet (LKS) to enhance students' mathematical creative thinking skills.

## METHOD

This study employs a research and development (R&D) approach. The development procedure of the interactive multimedia-based student worksheet (LKS) on the topic of arithmetic sequences and series follows the ADDIE development model, which consists of five main stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation (Riwayati et al., 2020), (Atmojo et al., 2024). In this study, however, the ADDIE model was modified to include only three stages: (1) Analysis, (2) Design, and (3) Development. The remaining stages—(4) Implementation and (5) Evaluation—will be conducted in subsequent research. The modified ADDIE model diagram was adapted from (Sampoerno et al., 2023).




**Gambar 1**. Langkah-langkah Model 3D

In the analysis stage, obstacles encountered during the learning process are identified. This stage includes: (1) needs analysis, (2) curriculum analysis, and (3) analysis of student characteristics. During the design stage, the development of the interactive multimedia-based student worksheet (LKS) is planned, including the creation of validation sheets and student response questionnaires in the form of practicality sheets, which were carried out manually. The development stage involves assembling the components of the LKS and proceeding with expert validation assessments. In the implementation stage, the validated interactive multimedia-based LKS is applied in a limited small-group trial to evaluate its readability and initial effectiveness. The final step, the evaluation stage, aims to provide both formative and

summative evaluations. The results of this evaluation are used to assess the overall quality and effectiveness of the developed product.

The research was conducted at SMA Negeri 6 Bengkulu City with Grade X students during the 2024/2025 academic year. The subjects of this study were students from class X-3 at SMA Negeri 6 Bengkulu City.

**Data Collection Techniques**

The data collection techniques used in this study included observation, interviews, questionnaires administered after learning using the interactive multimedia-based student worksheet (LKS), and tests. In the observation stage, the researcher conducted fieldwork directly to collect data. This stage is crucial for obtaining more accurate and in-depth information about the observed subject. Interviews were carried out with both teachers and students to gather preliminary information. These interviews were conducted in a structured and systematic manner, following an interview guide that had been prepared in advance. The interview stage served as a means to explore information related to the research topic more deeply and to clarify responses when necessary. Questionnaires were used to assess the validity of the product as evaluated by expert validators and to measure its practicality from the students' perspective.

Data were gathered using research instruments designed to assess the validity and practicality of the interactive multimedia-based LKS. The effectiveness of the LKS will be examined in a subsequent study.

Students' mathematical creative thinking skills were measured using several instruments, including expert validation sheets, student response questionnaires, and a mathematical creative thinking skills test based on competency achievement indicators for the topic of arithmetic sequences and series.

**Data Analysis Techniques**

This study employed both qualitative and quantitative data analysis techniques. Qualitative data were derived from interviews, observations, and expert and practitioner feedback following the use of the interactive multimedia-based LKS. These data were analyzed using descriptive analysis to evaluate how the LKS stimulated students' mathematical creative thinking skills. Quantitative data analysis was used to evaluate the validity and practicality of the LKS.

**Validity Analysis of the Interactive Multimedia-Based LKS**

The validity analysis was conducted using the following formula

$$V = \frac{\sum v}{N} \quad (1)$$

Explanation:

V = Average validity score

$\sum v$ = Total score

N = Total number of scores

The validity assessment criteria used are as follows.

**Tabel 1**. Validity Criteria

| Score Range | Category |
|---|---|
| V≥ 3,0 | Very valid |
| 3,0 > V ≥ 2,5 | Valid |
| 2,5 > V ≥ 2,0 | Less valid |
| V≤ 2,0 | Not valid |

**Practicality Analysis of the Interactive Multimedia-Based Student Worksheet (LKS)**

The practicality analysis was calculated using the following formula.

$$V_p = \frac{TSEp}{S_{Max}} x100\% \quad (2)$$

Explanation:

$V_p$ = Practicality validity score

TSEp = Total empirical practicality score

$S_{Max}$ = Maximum expected score

The practicality criteria for the developed interactive multimedia-based student worksheet (LKS) are as follows:

**Table 2**. Practicality Criteria

| Score Range | Category |
|---|---|
| 76%-100% | Very Practical |
| 51%-75% | Practical |
| 26%-50% | Less Practical |
| 0%-25% | Not Practical |

## RESULT AND DISCUSSION

This study is a development research conducted at SMA Negeri 6 Bengkulu City on the topic of Arithmetic Sequences and Series, using the ADDIE development model as follows.

### Analysis

The analysis stage included needs analysis, curriculum analysis, and student analysis. Based on the needs analysis, it was found that the availability of teaching materials in the school was still limited. As a result, the printed instructional materials presented tasks that lacked real-life applications and did not sufficiently guide or stimulate students to develop their own mathematical creative thinking skills. Interviews with students revealed that they preferred learning mathematics using digital media that integrates video, animation, audio, and visual components. Therefore, it was concluded that there is a need for the availability of teaching materials in the form of interactive multimedia-based student worksheets (LKS) that can foster the development of students' mathematical creative thinking abilities.From the curriculum analysis, it was found that SMA Negeri 6 Bengkulu City implements the *Merdeka Curriculum* (Independent Curriculum) for the topic of arithmetic sequences.

The student analysis aimed to identify the level of students' intellectual development and prior knowledge. From the perspective of intellectual development, students are over 12 years old and are thus in the formal operational stage. At this stage, students are capable of constructing their own knowledge to solve problems and make systematic conclusions. Reasoning at the formal operational stage is characterized by the ability to think abstractly, organize ideas, and reason logically about potential outcomes. Further observations indicated that during the learning process, students are generally accustomed to relying on guidance and instructions from the teacher when completing tasks.

Based on the cognitive development of high school students, they possess the ability to think creatively according to the characteristics of their thinking processes. At this stage, students are capable of directly engaging in meaningful learning processes, enabling them to develop information to a higher cognitive level more easily.

### Design

In the design stage, the development of an interactive multimedia-based student worksheet (LKS) was carried out in terms of content, visual design, and the construction of test instruments to assess students' mathematical creative thinking skills. The content design included components such as a cover page, foreword, introduction to the interactive multimedia-based LKS, user instructions, learning competencies, and the worksheet activities themselves.

The visual design focused on incorporating text, images, and animations to create a more engaging appearance. The LKS was designed with attractive colors and visuals to enhance student interest. It presents non-routine problems drawn from everyday life situations, aimed at stimulating students' mathematical creative thinking skills. The design of the test for creative mathematical thinking skills was based on a test blueprint aligned with specific indicators of students' mathematical creative thinking abilities. The questions were developed in accordance with these indicators to ensure they accurately measure the intended competencies.

**Development**

In the development stage, the output included the design of the interactive multimedia-based student worksheet (LKS) and expert validation testing. The layout of the interactive multimedia-based LKS consisted of a cover page, foreword, table of contents, student identity section, user instructions, learning competencies, concept map, introductory material overview, and activity sheets. The activity section was divided into two main parts: sequences and series.

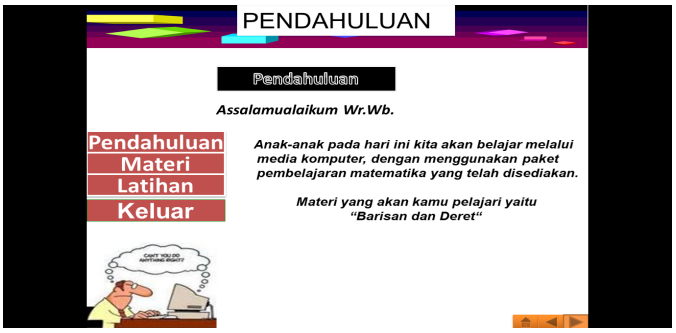



**Figure 2.** Opening Page Display of the Interactive Multimedia-Based Student Worksheet (LKS)

Furthermore, in the section that assesses students' mathematical creative thinking skills, objective-type questions are presented. When students select the correct answer, the correct response is automatically displayed. Conversely, if they choose an incorrect answer, a notification appears indicating that the answer is incorrect, and students are prompted to review their responses. Through this interactive multimedia-based worksheet (LKS), students receive immediate feedback. As a result, the learning process becomes more engaging, especially when students feel challenged by the problems presented, which stimulates their curiosity and desire to explore further.

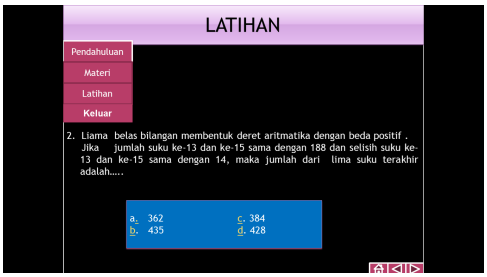



**Figure3.**Question in the Interactive Multimedia-Based Worksheet– Mathematical Creative Thinking Section

Before conducting field trials, the interactive multimedia-based student worksheet (LKS) was first validated by three experts in media and content. The purpose of this validation was to produce a final product that is valid, having been revised based on feedback and suggestions from the validators regarding the strengths and weaknesses of the developed product. This process ensures that the product is improved before being implemented with a group of students to evaluate its feasibility and practicality.

**Table 3.** Average Validation Results

| No | Validation Sheet | Average Score | Category |
|---|---|---|---|
| 1 | Media Expert | 3,67 | Very Valid |
| **2** | Content Expert | 3,61 | Very Valid |

| | | | |
|---|---|---|---|
| **3** | Student Response Questionnaire | 3,72 | Very Valid |
| 4 | Mathematical Creative Thinking Test Instrument | 3,71 | Very Valid |

***Implementation***

At the implementation stage, a limited trial was conducted. The results of this limited trial led to a minor revision in the LKS, specifically the replacement of the word *"sedangkan"* ("whereas") with *"dan"* ("and") in one of the arithmetic series questions to eliminate ambiguity and make the question easier for students to understand.Furthermore, the limited trial yielded a practicality score of 78.3% based on the student response questionnaire, indicating a high level of usability for the interactive multimedia-based LKS. However, the LKS was only tested in a limited setting and has not yet undergone a full field trial due to time and budget constraints. The field trial is planned for the next phase of the research. In conclusion students gave positive responses to the interactive multimedia-based LKS, as reflected by the student questionnaire result of 78.3%.

***Evaluation***

During the evaluation stage, improvements were needed in the interactive multimedia worksheets (LKS), such as replacing the "click" button used to open the worksheet to make it more engaging. Additional information or functions for each button displayed on the screen should be provided, along with allocating a larger space for the display of instructional videos. The evaluation of the test items focused on the use of standard grammar and the cognitive level of the questions to ensure alignment with the operational verbs and indicators of students' mathematical creative thinking skills.

Interactive multimedia-based worksheets (LKS) are considered valid when evaluations by three media and content experts of the developed interactive digital worksheets meet the validity criteria. The validation results showed that the interactive multimedia-based LKS met the criteria of being highly feasible, with an average score of 3.61 from content experts and 3.67 from media experts—both categorized as highly feasible.The practicality of the developed interactive multimedia-based LKS was assessed based on students' responses. The analysis of student response questionnaires yielded a score of 78.3%, placing the LKS in the "highly practical" category. This is in accordance with the practicality guidelines used by the researcher, which categorize a tool as highly practical if it achieves a practicality score between 76% and 100%. Similarly, research by (Ningrum et al., 2023) found that the developed interactive digital worksheets met the practicality criteria within the 76%–100% range.

The practicality of interactive digital LKS is reflected in terms of ease of use, time efficiency, and functional benefits. The materials are equivalent to other teaching resources and are attractive to students, as indicated by a student response rate of 77.03%. Similarly, the study conducted by (Saputro & Akila, 2025) on the development of interactive multimedia based on Canva showed that media expert validation reached 91%, and content expert validation reached 94%, both categorized as highly appropriate. Furthermore, the responses from teachers and students were 93% and 100%, respectively, which also fall into the "highly appropriate" category. Thus, it can be concluded that the quality of Canva-based interactive multimedia on the topic of ordering numbers is highly suitable for use in teaching first-grade elementary school students.

In line with this, (Fitri Safrilia Rani, 2025) found that the engaging appearance of an interactive e-module in flipbook format stimulated the development of creative thinking skills and motivated students to engage more enthusiastically with the learning material.

This is supported by the findings of (Hidayah & Maharani, 2025), which showed that the use of interactive learning media in the form of Liveworksheet made it easier for students to understand mathematical

concepts and actively participate in the process of obtaining information to solve problems related to the given material. Similarly, the study by (Yarmayani & Simamora, 2022) revealed that learning through interactive multimedia using PowerPoint has its own uniqueness and characteristics. The PowerPoint media incorporated audio, video, and animations related to Calculus content, making the learning process more engaging and improving the delivery of the material. Consequently, students were able to utilize their mathematical creative thinking skills in constructing their own knowledge.

According to (Angraini & Fathiyyah Firdaus, 2022), learning using interactive multimedia resulted in university students demonstrating higher levels of mathematical creative thinking compared to those taught using conventional methods. Students were more actively engaged in asking and answering questions, showed greater motivation to learn, and exhibited a stronger curiosity toward the subject matter being taught.

According to recent findings, the integration of interactive multimedia-based worksheets (LKS) into mathematics instruction enhances students' focus and interest, making learning more engaging and flexible. It promotes active student participation in solving mathematical problems and supports independent knowledge construction. This approach encourages students to express their ideas confidently and reduces boredom during class activities. The worksheets are also designed to align with indicators of creative mathematical thinking, specifically fluency, flexibility, and elaboration (Riwayati et al., 2020)

## CONCLUSION

The interactive multimedia-based student worksheet (LKS) is considered valid if the assessments from three media and content experts meet the established validity criteria. The validation results of the interactive multimedia-based LKS indicated that it was highly appropriate, with the content expert validation scoring an average of 3.61 and the media expert validation scoring an average of 3.67, both falling into the "highly valid" category.

In terms of practicality, student response analysis showed a score of 78.3%, placing the LKS in the "highly practical" category. This practicality was reflected in the ease of use, time efficiency, perceived usefulness, and the engaging multimedia design that increased student motivation.

Moreover, the implementation of the LKS encouraged student engagement, focus, and active participation in problem-solving. The tasks provided in the LKS aligned with the indicators of mathematical creative thinking—fluency, flexibility, elaboration and original—which are essential for fostering higher-order thinking skills. Therefore, the developed interactive multimedia-based LKS can be considered an effective alternative learning material to support meaningful and creative mathematics learning.

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