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Developing Liveworksheet Using Cooperative NHT Model: Improving Students' Mathematical Problem-Solving Skills

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Abstrak

Penelitian ini dilatarbelakangi oleh pentingnya pengembangan LKPD yang disesuaikan dengan tuntutan era teknologi dan siswa jarang mendapatkan LKPD software yang dapat mempermudah dalam memahami materi dan mudah dibawa kemana-mana. sehingga peneliti mengembangkan LKPD elektronik berbasis liveworksheet dengan model kooperatif Numbered Head Together (NHT). Pengembangan ini dilakukan untuk meningkatkan kemampuan pemecahan masalah matematis siswa dalam materi bangun ruang sisi lengkung. Adapun model pengembangan yang digunakan oleh peneliti yaitu model pengembangan ADDIE (Analysis, Design, Development, Implementation, Evaluation) yang merupakan model pengembangan sistenatis, terstruktur, terarah dan terencana. Penelitian ini mengguanakan intrumen penelitian yang berupa angket yang di berikan kepada siswa-siswi sekolah menengah pertama (SMP) kelas IX. Angket yang dibagikan bertujuan untuk mengetahu karakteristik peserta didik, kebutuhan peserta didik terhadap LKPD yang dikembangkan. hasil analisis kebutuhan, peneliti berhasil mengembangkan LKPD berbasis elektronik menggunakan platform Liveworksheet. Produk LKPD ini memiliki keunggulan efisiensi dan efektivitas, serta melibatkan unsur audio visual dan diskusi siswa untuk membangun pemahaman dan kemampuan pemecahan masalah. Diharapkan pengembangan ini dapat memberikan pengalaman belajar yang interaktif, menarik, dan membantu siswa dalam mengembangkan kemampuan pemecahan masalah matematis.

Abstract

This research is motivated by the importance of developing worksheets (LKPD) that are tailored to the demands of the technological era. Therefore, the researcher developed an electronic LKPD based on Liveworksheet with the cooperative model of Numbered Head Together (NHT). This development was carried out to enhance students' mathematical problem-solving skills in the topic of curved surface solids. The researcher employed the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model, which is a systematic, structured, directed, and planned model. The research utilized a questionnaire as the research instrument, which was distributed to ninth-grade students in a junior high school (SMP). The questionnaire aimed to gather information about the characteristics of the students and their needs regarding the developed LKPD. Based on the analysis of the needs, the researcher successfully developed an electronic LKPD using the Liveworksheet platform. This LKPD product offers the advantages of efficiency and effectiveness, incorporating audio-visual elements and student discussions to enhance understanding and problem-solving abilities. The development is expected to provide an interactive and engaging learning experience, helping students to develop their mathematical problem-solving skills

INTRODUCTION

In learning, teaching materials are essential. Teaching materials are any form of systematically arranged materials that enable students to learn independently and are designed in accordance with the applicable curriculum (Magdalena, 2020). The development of Student Worksheets (LKPD) tailored to the demands of the technological era is crucial, as students seldom have access to software-based LKPD that can facilitate understanding of the material and be easily carried around. Teaching materials need to be continuously developed due to the evolving needs in the field of education. The development of LKPD should be aligned with the demands of the technological era. Students rarely have access to software-based LKPD that can

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facilitate understanding of the material and be easily carried around. As expressed by Oktaviyanthi & Herman in (Lestari, 2018), utilizing interactive teaching materials, especially in integrating mathematics software, can aid students in comprehending concepts. By developing teaching materials, teachers can update and enhance the relevance and effectiveness of the learning material delivered to students. The development of teaching materials can also help address changes in curriculum demands and new educational standards (Suprihatin & Manik, 2020). Depdiknas in (Supriatna, et al., 2022) also states that teaching materials can assist teachers by emphasizing student involvement, facilitating students in understanding the material, providing tasks for student practice, and simplifying the learning process.

By utilizing technology, it is possible to create a conducive learning environment as it accelerates and simplifies tasks for students, enhancing their ability to leverage technological advancements (Ambarwati, 2021). Additionally, integrating innovative learning approaches, efficient teaching methods, and engaging resources through recent technological and research advancements can enrich instructional materials. This approach fosters greater student engagement, strengthens understanding, and facilitates improved learning outcomes (Wahyudi, 2022). Therefore, the development of instructional materials becomes crucial in enhancing educational quality and achieving effective teaching and learning activities.

One essential instructional material is Student Worksheets (LKPD). Student Worksheets serve as learning media containing content summaries and task guidelines that students need to complete. They encompass both theoretical and practical aspects aligned with the basic competencies students are expected to achieve (Trisna, 2021). Traditional LKPD are often in print form; hence, electronic-based LKPD (E-LKPD), like Liveworksheets, are necessary for universal accessibility by all students, facilitating easier access and interaction (Hidayati & Zulandri, 2021).

Electronic LKPD, such as those developed on platforms like Liveworksheets, are interactive and systematically provide exercises that students can digitally engage with over time (Ramlawati et al., as cited in Hidayati & Zulandri, 2021). Liveworksheets integrate text, images, animations, and videos to make learning more engaging, thereby combating student boredom (Khikmiyah, 2021). Features like multimedia content, interactive quizzes, and dynamic images enrich the learning experience, increase student involvement, and foster motivation (Andriyani et al., 2020). Moreover, utilizing online technologies allows LKPD to be accessed and used by students anytime and anywhere, facilitating effective distance learning (Gitriani et al., 2018).

The appropriate learning model in the development of LKPD based on liveworksheet aimed at enhancing students' mathematical problem-solving abilities is the Numbered Head Together (NHT) cooperative learning model (Noor & Megawati, 2014). In the NHT model, each student is assigned a unique number and they collaborate within groups to solve problems or answer questions. Utilizing the Numbered Head Together (NHT) model in LKPD development offers significant benefits. NHT fosters collaborative methods that can enhance students' independence and reinforce their responsibility to contribute optimally within their groups (Khoiriyah, 2018). Thus, each student feels accountable and engaged in the learning process. Moreover, NHT also helps mitigate the dominance of more active students in the classroom. Several studies have shown that implementing the NHT model in LKPD development effectively improves students' mathematical problem-solving abilities, as noted by Hartati (2015) in the context of spatial geometry.

Through NHT, each group member is assigned a number and confronted with the same questions or tasks. This encourages productive group discussions and enables students to build shared knowledge and deepen their understanding. The model also promotes active participation from every group member, developing teamwork skills and communication abilities, as well as enhancing students' problem-solving capabilities (Tinambunan et al., 2020).

Enhancing students' mathematical problem-solving skills holds significant benefits. These skills are crucial not only in academic contexts but also in everyday life. Mulyati (2016) stresses that problem-solving is a fundamental skill that students must master after learning mathematics. Therefore, teachers should ensure students acquire adequate problem-solving

skills by providing appropriate exercises. As students develop these skills, they become more confident and effective in tackling mathematical challenges. Mathematical problem-solving helps students develop critical thinking skills essential for interpreting information, analyzing situations, and making informed decisions. It also trains them to identify problems, formulate solution strategies, and test their findings (Mulyati, 2016).

Improving mathematical problem-solving in LKPD development based on NHT offers significant advantages in mathematics education. It involves critical skills such as creative, analytical, and logical thinking. Integrating mathematical problem-solving into NHT-based LKPD engages students actively in seeking solutions and applying mathematical concepts in real-world contexts. This process enhances their critical and analytical thinking skills and improves their problem-solving abilities for application in daily life. Additionally, collaboration within NHT groups allows students to share problem-solving approaches and strategies, thereby enhancing their understanding and perspectives (Tinambunan et al., 2020).

METHOD

The development of LKPD based on Liveworksheet using the ADDIE model is chosen due to its systematic and structured approach that enhances the efficiency and quality of the development process. Firstly, the Analysis phase assists in gaining a deep understanding of the needs and characteristics of the target audience, as well as the learning context. Through comprehensive analysis, researchers can identify problems or challenges that need to be addressed in learning and formulate clear objectives. ADDIE model was schematized by Branch in (Hidayat & Muhammad, 2021) as a learning system design as follows;

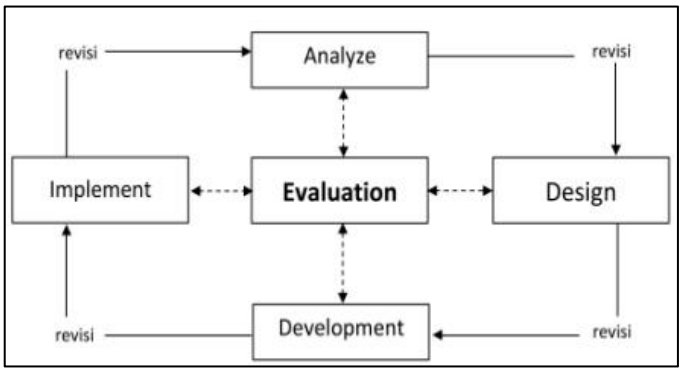


Figure 1. Procedure of ADDIE Model

The selection of the ADDIE model for developing Student Worksheets (LKPD) is based on its systematic and structured approach. The ADDIE model comprises five main stages: Analysis, Design, Development, Implementation, and Evaluation. The Analysis stage allows developers to gain a deep understanding of student needs, audience characteristics, and relevant learning contexts. Through comprehensive analysis, developers can identify challenges or issues in learning that need to be addressed and formulate clear objectives tailored to learning needs (Hidayat & Muhammad, 2021). The Design stage enables developers to design LKPD by considering various appropriate teaching strategies, while the Development stage allows the implementation of these design ideas into tangible forms usable in the teaching and learning process. The entire ADDIE process ensures that the resulting LKPD is not only relevant to student needs but also effective in achieving the established learning objectives.

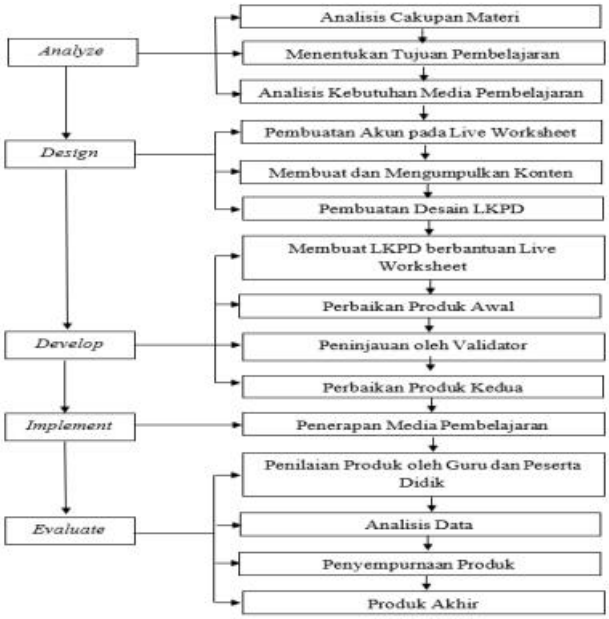


Figure 2. Development Phase (Marlina, 2022)

The Design phase involves planning the structure and learning content centered around learning objectives. In this step, methods or learning strategies are determined, and a learning model is chosen for implementation in teaching materials such as LKPD (Harjanta & Bambang, 2018). According to Rustandi & Rismayanti (2021), in the design phase, activities begin with designing flowcharts, storyboards, compiling materials, assessment instruments, and gathering supporting materials. Through thorough design, researchers can create a logical sequence of learning, select appropriate methods and media, and integrate effective teaching strategies. The Development phase entails creating learning materials that align with the designed structure. In this stage, researchers develop teaching materials, test them, and revise them to ensure the quality and suitability of the learning materials to be used.

The Implementation phase involves applying the developed learning materials in real-world contexts. In this stage, the developed materials are applied in the learning process to evaluate their impact on learning quality, including effectiveness, attractiveness, and efficiency (Puspasari & Tutut, 2019). Researchers observe student interactions and responses to the learning materials, identify shortcomings, and make adjustments as necessary. Implementation is done in small groups to obtain feedback for refining the product draft.

The Evaluation phase allows researchers to assess the effectiveness of the learning materials and improve them. Evaluation is conducted in two forms: formative evaluation and summative evaluation (Nareswari et al., 2021). Various methods such as tests, surveys, or observations can be used for evaluation. Evaluation results provide valuable insights for enhancing and improving the developed learning materials.

By using the ADDIE model, development can be conducted in a structured and planned manner. This model ensures that each crucial stage in developing teaching materials is carefully considered, thereby enhancing the efficiency and quality of the development process (Susanto & Ayuni, 2017). Moreover, with a systematic approach, researchers can adjust and refine learning materials based on feedback and evaluation, thereby producing more effective learning materials that meet students' needs.

RESULT AND DISCUSSION

Needs Analysis Result

The needs analysis results indicate that students have clear preferences for specific types of animations in the context of learning. Based on a series of animations provided, students choose animations based on their preferences for various aspects such as visual clarity

of concepts, level of interactive engagement, and quality of narration that supports understanding of the material.

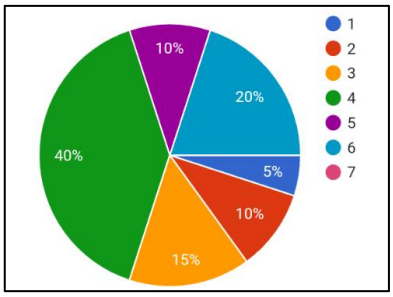


Figure 3. Students' Animation Preferences Data

Based on the survey results regarding students' preferred animations, it is shown that students favor animations numbered 4, 6, and 3. The animations chosen by the students are presented in Figure 1.

Figure 4. The illustrations chosen by the students

The needs analysis indicates that students have varied preferences regarding the type of fonts used in learning materials. Based on the data obtained, Poppins font emerges as the top choice with 35%, followed by Calibri at 25%, Cambria at 10%, and Arial at 30%. These preferences reflect students' inclination towards fonts that offer visual clarity, readability, and suitability for the learning context (Bernard et al., 2013; Zhang & Norman, 2014). Poppins font, known for its modern and legible characteristics, might be more appealing to younger students compared to more traditional fonts like Cambria (Tantillo, 2020). Meanwhile, fonts like Calibri and Arial, frequently used in formal documents, can facilitate students' consumption of information without significant visual distraction (Bernard et al., 2013).

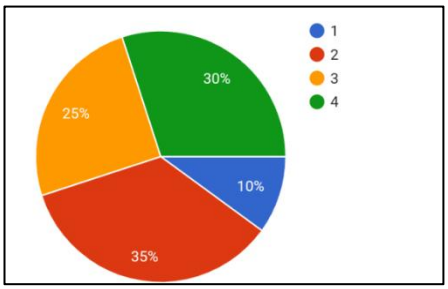


Figure 5. Types of fonts preferred by students

The needs analysis results indicate that the majority of students pay close attention to color composition in worksheets as a crucial factor in determining visual appeal and comfort. 60% of students agree and 40% strongly agree that worksheets with appropriate and

harmonious color compositions can create a comfortable feeling when used (Cheng et al., 2019; Ou & Luo, 2014). The selected colors should align with the learning content and not disrupt students' concentration, thereby supporting the learning process without causing visual fatigue or distraction (Bellizzi & Hite, 1992; Mehta & Zhu, 2009). By considering these preferences, the development of worksheets can optimize the use of color to enhance visual appeal and learning effectiveness.

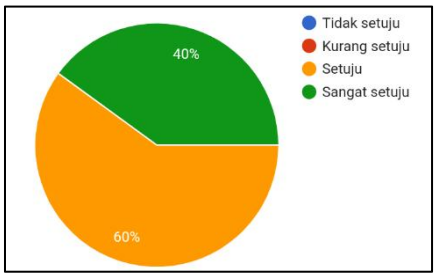


Figure 6. Color harmony creates eye comfort.

Based on the survey results as depicted in Figure 6, it was found that participants did not reject the idea that worksheets (LKS) would be more engaging with appropriate color composition and harmony, thus inducing a comfortable viewing experience. The use of colors in learning can enhance students' interest in studying the material, provide better focus on the presented content, and make information delivery more appealing. Colors can also influence students' psychological conditions during learning, through the color observation process that occurs in the brain, making individuals more aware of what they perceive through their senses (Purnama, 2010).

The needs analysis results also indicate that the majority of students pay close attention to the use of language appropriate to their maturity level in worksheets (LKS). 75% of students agree and 20% strongly agree that using easily understandable language is crucial for facilitating comprehension (Adesope & Nesbit, 2012; Mayer & Moreno, 2003). Complex or inappropriate language for students' comprehension levels can hinder their learning process (Clark & Mayer, 2011; Moreno & Mayer, 2007). Moreover, using appropriate language can enhance students' motivation in learning and facilitate their interpretation of presented information (Mayer, 2009; Sweller et al., 2011). Therefore, it is crucial for developers of worksheets (LKS) to choose language that aligns with their audience's characteristics to enhance learning effectiveness.

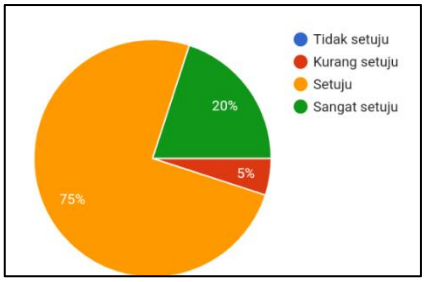


Figure 7. The Use of Language in Teaching Materials (LKPD)

The analysis of additional needs also indicates that the majority of students have previous experience with online learning and feel comfortable using smartphones or laptops as learning tools. 85% of students agree and 10% strongly agree that the ability to use these electronic devices greatly assists in accessing learning materials and interacting with content (Johnson et al., 2018; Sang et al., 2010). This technology enables students to utilize digital resources more effectively and enhances engagement in the learning process (Gikas & Grant, 2013; Lai & Hong, 2015). However, 5% of students express disagreement, possibly due to technical constraints or personal preferences for different learning methods (Lee, 2010; Selwyn, 2011). Therefore, the integration of technology in developing learning materials should consider the diversity of student experiences and preferences to maximize learning effectiveness.

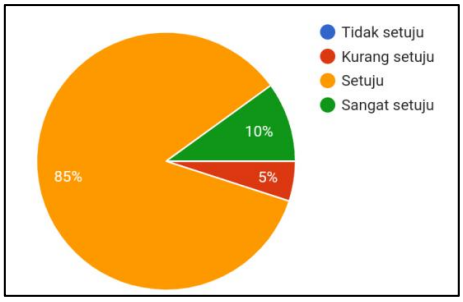


Figure 8. shows the use of smartphones or laptops by students.

Based on the questionnaire results, as depicted in **Figure 8**, it is evident that many students can use smartphones and laptops because they have already used them during online schooling. As noted by Salsabila et al. (2020), during the COVID-19 pandemic, education shifted entirely to online platforms using tools such as mobile phones and internet access. Therefore, the creation of worksheets (LKPD) can support students in their learning process.

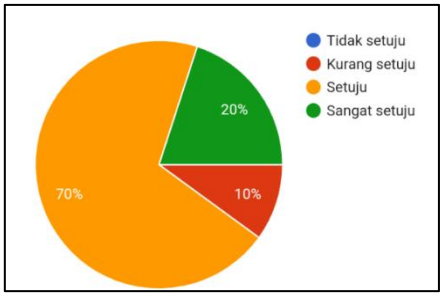


Figure 9. shows the mathematics lessons needed by the students.

Based on the survey results depicted in Figure 6, 70% of students require electronic worksheets (e-worksheets), especially in mathematics, because they find mathematics to be a difficult subject. They need learning resources that are easy to understand and can guide them in solving problems encountered in mathematics lessons.

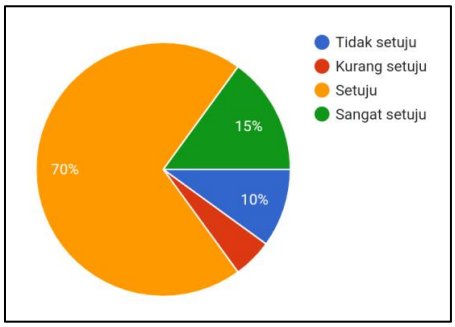


Figure 10. Color composition in the previous Student Worksheets (LKS)

Based on the survey results depicted in Figure 10, the majority of students (70% agree and 15% strongly agree) stated that the use of colors in the previous Student Worksheets (LKS) lacked appropriate composition except for its initial appearance. This indicates that consistent and cohesive color arrangement throughout the LKS documents still needs attention to enhance visual comfort and aid students' focus on learning materials (Bellizzi & Hite, 1992; Mehta & Zhu, 2009). However, a small percentage of students (10% disagree and 5% strongly disagree) consider the current color usage adequate, possibly due to individual preferences or differing evaluations of aesthetics and visual needs (Cheng et al., 2019; Ou & Luo, 2014). Therefore, the

development of future LKS should reconsider overall color arrangement to meet the majority's preferences and improve its effectiveness in the learning process.

The Results of Teaching Materials Design

In the design phase, there are several elements that need to be planned, including flowcharts, storyboards, and subsequently creating teaching materials (LKPD). According to Prastowo (2013), there are four main objectives in developing LKPD: 1) Presenting learning materials in a way that facilitates student interaction with the taught material, thus the researcher provides instructional videos incorporating audio and visual elements for better understanding. 2) Offering various types of tasks to enhance students' comprehension of the material. Utilizing the NHT learning model syntax also provides issues and multiple exercises to assist students in understanding and solving mathematical problems. 3) Assisting teachers in assigning tasks more efficiently. The live worksheet is an online learning platform that facilitates the process of task assignment and helps students in constructing their own knowledge. 4) Training students to learn independently. In developing LKPD, there are six main elements that should be included, as stated by Asmaranti et al. (2018): the title, providing guidance to students on using LKPD and participating in learning activities, basic competencies or core materials, explanations of skills or knowledge to be learned in LKPD, supporting information that includes additional explanations supporting students' understanding of learning material. Tasks or work steps containing instructions or activities to be performed by students in mastering the material they are studying. Furthermore, according to Batubara, H.H. (2018), one of the steps taken in designing teaching materials is to compile a flowchart. A flowchart is an overview of the teaching material flow developed (Findawati, 2014).

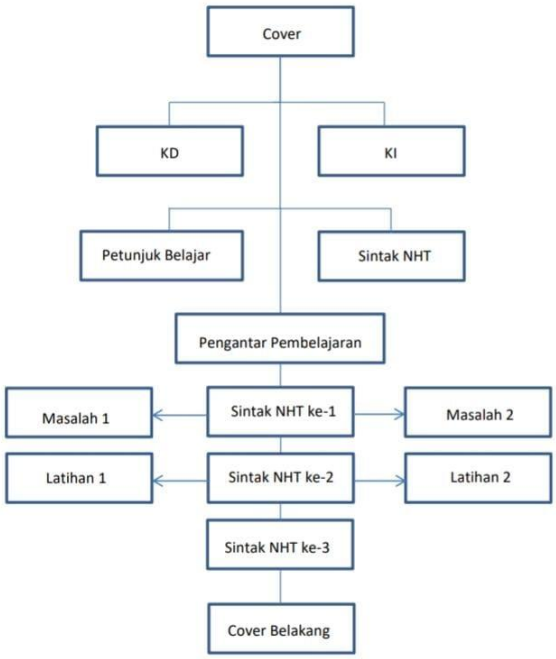
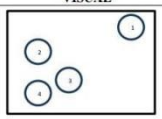
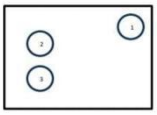
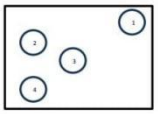
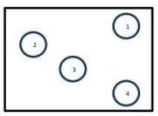
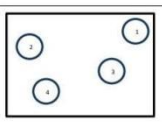


Figure 11. Flowchart of Live Worksheet-Based Student Worksheets

After designing the flowchart, the process continues with storyboard design. As stated by Rustandi and Rimayandi (2021), after designing the flowchart, the next step involves storyboard design.

No	VISUAL	KETERANGAN
1		1. Logo 2. Animasi 3. Judul 4. Biodata Siswa
2		1. Animasi 2. Kompetensi Dasar 3. Kompetensi Inti
3		1. Animasi 2. Petunjuk belajar 3. Sintak NHT 4. Animasi
4		1. Judul bangun ruang sisi lengkung 2. Petunjuk dan animasi 3. Video pembelajaran 4. Animasi
5		1. Animasi 2. Petunjuk 3. Pesan untuk berdoa 4. Doa sebelum belajar dan animasi

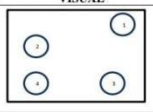
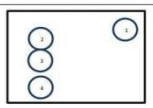
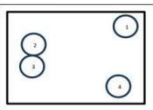
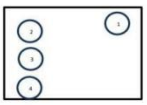
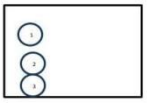
No	VISUAL	KETERANGAN
6		1. Jenis bangun ruang Tabung 2. Sintak NHT yang ke-1 3. Masalah 1 dan Animasi 4. Animasi
7		1. Animasi 2. Memahami masalah 4. Langkah pengerjaan 5. Animasi
8		1. Sintak NHT yang kedua 2. Latihan 1 3. Langkah pengerjaan 4. Animasi
9		1. Animasi 2. Sintak NHT yang ke-3 3. Animasi dan kesimpulan 4. Animasi
		1. Animasi 2. Judul 3. Kelas

Figure 12. Storyboard of Liveworksheet-based Student Worksheet

Based on the designed flowchart and storyboard, a student worksheet (LKPD) design was created and presented on a liveworksheet platform. Below is the design result of the liveworksheet-based student worksheet using the Numbered Head Together (NHT) Cooperative Learning Model to Enhance Students' Mathematical Problem-Solving Skills.

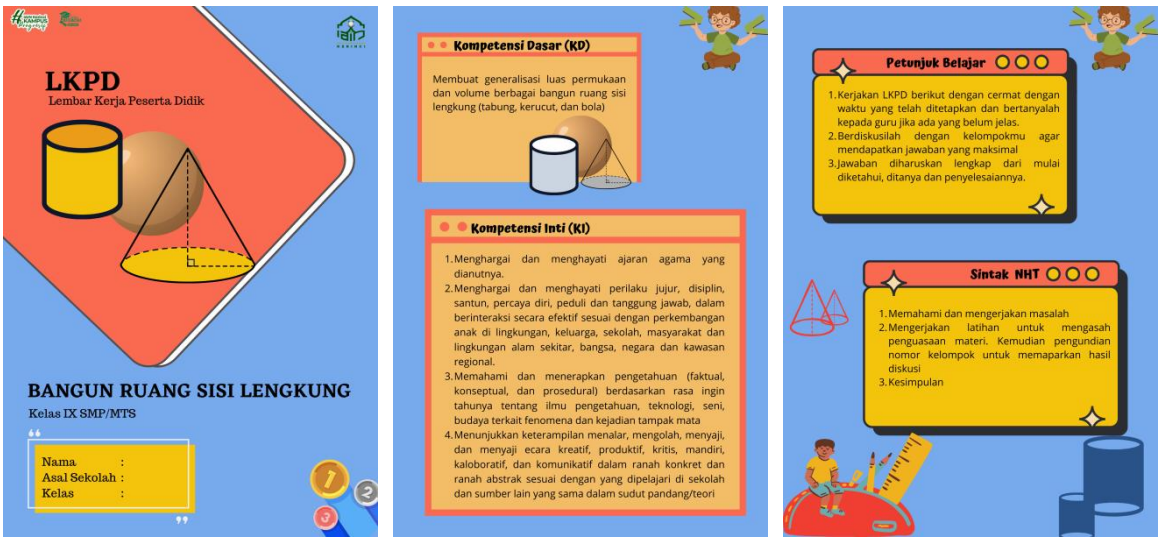


Figure 13. Student Worksheet Display

The cover inside the Student Worksheet (LKPD) contains student identities, namely their name, school of origin, and class of each student using the LKPD, as shown in Figure 11. Figure 12 displays the basic competencies (KD) and core competencies (KI). Basic competencies refer to specific and measurable abilities or knowledge expected to be possessed by students in a particular field or subject. These competencies are typically detailed in the curriculum and encompass skills, knowledge, attitudes, and values that students must master (Jundi & Solong, 2021). Similarly, Wina Sanjaya suggests that Basic Competencies (KD) combine knowledge, skills, values, and attitudes reflected in habits of thinking and acting.

Meanwhile, core competencies refer to general skills or abilities that students should have across various fields or subjects. Core competencies involve critical thinking,

communication, collaboration, and self-management skills, which are relevant and useful in daily life (Rachmawati, 2018). Core Competencies (KI) should reflect a balanced quality between achieving hard skills (technical skills) and soft skills (interpersonal skills). Worksheet presents instructions and syntax from the numbered together cooperative learning model. This is followed by a summary of the material in the form of instructional videos, as shown in Figure 14. The syntax of the numbered together cooperative learning model involves understanding and applying problems, working on exercises to refine mastery of the material. Subsequently, groups are randomly assigned numbers to present discussion outcomes and conclusions (Yolanda & Hasanah, 2022). In the understanding and applying problems phase, students are given two problems to solve. Here, students are required to understand the problems, plan problem-solving strategies, execute the plan, review the obtained results, and provide conclusions. These steps are performed within their respective groups according to the applied learning model. The next phase involves working on exercises to refine mastery of the material. Here, two exercise problems are provided, following the steps outlined in the previous phase, aiming to enhance students' mathematical problem-solving skills. Finally, groups are randomly assigned numbers to present discussion outcomes and conclusions from the various problems and exercises discussed.

Discussion

Based on the needs analysis, the researcher developed an electronic-based Student Worksheets (LKPD) product. This choice was made because electronic-based LKPD is highly demanded in the 21st century. To achieve this goal, the researcher utilized the Liveworksheet platform to support LKPD development. The development process followed the well-established ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Additionally, the cooperative learning model used was Numbered Head Together (NHT), aimed at enhancing students' problem-solving abilities in mathematics. The developed LKPD product excels over others by being more efficient and effective, facilitated by its electronic format. It also integrates audiovisual elements, such as summary videos on curved surface solids. Moreover, the LKPD includes various problems for student discussion to foster better understanding. Throughout these discussions, students draw conclusions independently, thereby improving their problem-solving skills and deepening their understanding. The development process also considered appropriate use of colors tailored to student characteristics and incorporated animations to align with the content, making LKPD engaging and aiding students in comprehending the taught mathematical concepts.

Research findings indicate that students' preferences for elements like animations, font types such as Poppins, color compositions, language clarity, and technology integration in LKPD significantly impact learning effectiveness (Bernard et al., 2013; Cheng et al., 2019; Zhang & Norman, 2014). Students tend to favor clear and engaging animations, easily readable fonts like Poppins, and harmonious color combinations to enhance visual comfort (Bellizzi & Hite, 1992; Zhang & Norman, 2014). The use of language appropriate to students' comprehension levels and effective technology integration also play crucial roles in increasing student engagement in the learning process (Adesope & Nesbit, 2012; Gikas & Grant, 2013). These findings underscore the importance of considering student preferences when designing more effective and engaging teaching materials.

This research is consistent with previous findings highlighting the importance of visual factors in learning. For instance, Bernard et al. (2013) found that appropriate use of animations can enhance students' understanding of abstract concepts. Similarly, Cheng et al. (2019) emphasized the significance of suitable color composition in creating a comfortable learning environment. Zhang & Norman (2014) also indicated that font preferences can affect the clarity and visual appeal of learning materials. The theoretical underpinnings supporting these findings include psychological theories of visual perception and learning. Clark & Mayer (2011) suggested in their multimedia learning theory that well-organized visual stimuli can facilitate more effective information processing. Mayer (2009) demonstrated that carefully chosen visual elements can improve information retention in learning.

Integration of technology in education has also been reinforced by previous studies highlighting the benefits of electronic devices in enhancing accessibility and student engagement (Gikas & Grant, 2013; Lai & Hong, 2015). These studies indicate that technology not only facilitates access to information but also enables more dynamic interaction between students and learning materials.

The researcher assumes that students' preferences for visual elements and technology in instructional materials can be interpreted as efforts to create a learning environment tailored to modern students' needs and preferences. Cognitive theories of visual learning suggest that using well-designed visual stimuli can enhance material retention and understanding (Moreno & Mayer, 2007). In this context, the selection of elements such as clear animations, easy-to-read fonts, and harmonious color compositions can strengthen the teaching and learning process. By considering students' preferences for visual elements and technology in instructional materials, the development of learning materials can be optimized to improve learning quality. Integrating theories of visual learning and technology in instructional design approaches can help create a more effective and engaging learning environment for students. Therefore, the development of instructional materials that considers these aspects is expected to better support the achievement of learning objectives.

The development of teaching materials in the form of worksheets (LKPD) using technologies like liveworksheets aims to enhance the mathematical problem-solving abilities of 9th-grade junior high school students. This approach utilizes the Numbered Head Together (NHT) cooperative model, ensuring interactive learning experiences through visually appealing features such as audio-visual displays, animations, and carefully chosen color compositions. These elements are designed to create a comfortable learning environment and increase student interest in the curriculum-aligned materials, specifically tailored to the 2013 curriculum (Amalia & Lestyanto, 2021).

Previous studies by Amalia & Lestyanto (2021) focused on developing scientifically-based LKPD using live worksheets to enhance mathematical concept comprehension in social arithmetic, emphasizing validity, effectiveness, and practicality. In contrast, earlier research lacked audio-visual components and optimal color combinations, resulting in less visually engaging materials primarily in white with minimal orange accents. Similarly, Marlina (2022) explored liveworksheet-based LKPD effectiveness in teaching permutation and combination topics, highlighting the benefits of incorporating audio-visual elements and appealing color schemes, unlike previous studies. In this context, the researcher's approach emphasizes the ADDIE development model, known for its systematic and structured framework, ensuring a focused and planned creation of LKPD. This methodological choice aligns with Nurcahyo et al. (2021), who advocate for ADDIE's ease of implementation and systematic stages, yielding efficient and creative educational products. By integrating cooperative learning models like NHT and enhancing visual appeal with educational animations and suitable color compositions, the developed LKPD aims to empower students towards independent learning and foster a comfortable learning experience (Amalia & Lestyanto, 2021; Marlina, 2022; Nurcahyo et al., 2021).

CONCLUSION

Based on the needs analysis, it was found that students respond positively to Liveworksheet-based Student Worksheets (LKPD), especially in mathematics learning. The data indicates a high demand for LKPD, with 90% of students expressing a need—70% agreed and 20% strongly agreed. Specifically, regarding different aspects of LKPD: 60% (agree) and 40% (strongly agree) found the color coordination suitable; language usage in LKPD tailored to students' maturity levels received 75% (agree) and 20% (strongly agree); 85% (agree) and 10% (strongly agree) found students capable of operating smartphones or laptops; guidance usage in LKPD received 85% (agree) and 15% (strongly agree); and electronic LKPD needs were at 70% (agree) and 15% (strongly agree). The research highlights that student preferences for animation, fonts, colors, language, and technology significantly influence their engagement and

understanding in mathematics education. These findings imply that instructional material development should consider students' visual, auditory, and technological preferences to enhance learning effectiveness. However, due to limited sample size and geographical coverage, cautious generalization is advised. Future research should expand samples, explore technology use further, and integrate recent psychological and educational theories to support the development of more effective and inclusive LKPD for diverse learners.

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