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ANALYSIS OF THE NEEDS OF INTERACTIVE E-LKPD ASSISTED BY VIRTUAL SIMULATION AND ISPRING HIGH SCHOOL PHYSICS SUITE

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ABSTRACT

Physics learning at the high school level currently still faces major obstacles in the form of high student saturation levels and low understanding of concepts due to the monotonous use of conventional teaching materials and lack of training in problem-solving skills. This mixed methods research with a survey approach aims to analyze the need analysis of the development of interactive E-LKPD based on virtual simulation using iSpring Suite software with the Problem Based Learning (PBL) model as an innovative solution in physics learning. The research subjects consisted of physics teachers and 36 students from high schools in Medan in 2 schools. Data were collected through Likert scale questionnaires and interviews, then analyzed using quantitative descriptive techniques and qualitative analysis. The results of the analysis showed that 69.4% of students experienced saturation with the printed LKPD currently used and had difficulty in solving formula-based story problems because of the inability to apply contextual learning models. Meanwhile, teachers face limitations in visualizing abstract phenomena due to the lack of projector devices in the classroom. The crucial finding noted that students need interactive and multimedia gadget-based digital teaching materials. This study concludes that the development of interactive E-LKPD through the iSpring Suite that integrates virtual simulation and Problem Based Learning syntax is urgent to be developed. This teaching material is expected to present the orientation of real-world problems in a multimedial manner, decentralize laboratory functions directly to students' devices, and break the chain of memorization of mechanical formulas in order to boost students' interest, independence, and problem-solving skills.

Keywords: Interactive E-LKPD; iSpring Suite; Problem Based Learning; Virtual Simulation.

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INTRODUCTION

Teaching materials are all forms of materials used to assist teachers or instructors in carrying out the learning process. According to Prastowo (2021), teaching materials are a set of materials that are arranged systematically, both written and unwritten, so as to create an environment or atmosphere that allows students to learn. Teaching materials have a dual function, namely as a source of information for students as well as a guide for teachers in carrying out targeted and meaningful learning. The components of good teaching materials include competencies that must be mastered, materials, examples, exercises, and evaluation.

One of the most widely used forms of teaching materials in physics learning is the Student Worksheet (LKPD). LKPD is sheets that contain tasks that must be done by students and are usually in the form of instructions or steps to complete an assignment, either in the form of theoretical tasks or practical tasks. According to Widjajanti in Nurdin and Adriantoni (2019), a good LKPD must meet several criteria, including having the suitability of the material with basic competencies, using language that is easy to understand, having an attractive appearance, and being able to encourage students to think actively and independently.

Physics learning is one of the crucial components in the science education system which aims to develop scientific, logical, critical, and creative thinking skills in students. In today's modern era, the demands of learning quality are no longer limited to the aspect of mastering the concept of memorizing formulas, but include higher *order thinking skills (HOTS).* Facione (2020) states that critical thinking is defined as a cognitive process that results in interpretation, analysis, evaluation, and inference, as well as an explanation of the consideration of conceptual evidence that is the basis for assessment. The characteristics of physics that are full of empirical problem solving require deep logical reasoning. In line with that, Sudibyo et al. (2022) proved in their research that learning that systematically designed to train high-level cognitive activities has been proven to be able to significantly improve the critical thinking skills of high school students up to 32.7%.

However, the expectations of the curriculum are inversely proportional to the reality on the ground. Physics learning at the high school level is still often dominated by a conventional *teacher-centered* approach. Widodo and Kadarwati (2021) revealed that the dominance of lecture methods and the provision of routine procedural practice questions indirectly inhibits the development of critical thinking skills because it eliminates space for students to argue independently. This bitter reality is clearly recorded in a preliminary study at SMAN X and SMA Y in Medan, where physics teachers experience obstacles in the form of limited technological facilities such as the lack of classroom projectors that force them to compete with other teachers, and the absence of adequate practicum media to visualize abstract materials. As a result of these physical limitations, physics learning is again stuck in the one-way lecture method and monotonous use of whiteboards.

The structural gap is exacerbated by the quality of the teaching materials used in the classroom. The conventional printed Student Worksheet (LKPD) that is currently circulating is considered to have failed to be a stimulator for critical thinking. Rosana et al. (2020) stated that conventional LKPD tends to have a less attractive appearance and the content is purely informative-descriptive without encouraging students' high-level cognitive activity. Reality in the field shows that 69.4% of students complain that printed LKPD makes them bored quickly because of its monotonous appearance (admitted by 66.7% of students), and 72.2% of students feel that they always depend on the teacher's explanations. The psychological impact, 69.4% of students admitted that they immediately felt confused and lazy when reading long physics stories due to the habit of memorizing mechanical formulas without understanding their physical meaning. Rahmatika et al. (2023) in their study confirmed that the weakest indicator of students' critical thinking lies in the ability to evaluate arguments and make inferences, which is absolutely due to the low quality of supporting teaching materials provided by schools.

To overcome this problem-solving, the development of digital technology offers a modern comparative solution that is very accurate through the reconstruction of teaching materials in the form of interactive Electronic-LKPD (E-LKPD). Prastowo (2021) explained that digital teaching materials have significant comparative advantages over print media because they are able to integrate multimedia elements such as animated videos, dynamic images, and live feedback to create a rich and responsive learning environment. More specifically, Siagian and Sihombing (2022) stated in their research that the development of E-LKPD equipped with tiered analytical questions was able to stimulate the critical thinking skills of high school students by 27.3%.

As a form of comprehensive instructional problem-solving, this study offers the integration of new digital media by utilizing *the iSpring Suite software* combined with Virtual Simulation technology. Mulyatiningsih (2020) stated that *the iSpring Suite software* is a reliable tool to transform ordinary presentation documents into HTML5-based interactive digital teaching materials that are rich in features, such as interactive quizzes with instant feedback, audio-video recordings, to controlled navigation that is compatible with access via gadgets (smartphones). In this iSpring Suite-based E-LKPD container, Virtual Simulation technology is embedded. Meilina, Rohmah, and Farikha (2023) in their literature study emphasized that the use of virtual simulations or virtual laboratories is very effective in physics learning because it is able to replicate interactive computer programs that visualize abstract, microscopic, or mathematical concepts that are difficult to reach through ordinary sensory observations, as well as being a solution to the limitations of real practicum tools economically and safely.

This structured integration between E-LKPD, *iSpring Suite*, and Virtual Simulation directly decentralizes the visualization of physics concepts directly into the hands of individual learners. The presence of *the iSpring Suite* acts as an architect of an interactive teaching material flowline, while the virtual simulation acts as a dynamic digital laboratory where students explore free and bound variables in *real-time*. This combination breaks the chain of limitations of classroom projectors, drastically reduces learning saturation, and facilitates students' independent learning. The urgency of this innovation is validated by the results of the questionnaire, where physics teachers gave the green light to the need for cellphone-based interactive media, and supported by 69.4% of students in the field who expressed interest in using the interactive E-LKPD.

Based on all the descriptions of the gaps and potential solutions above, this preliminary study was conducted. The purpose of this study is specifically to analyze the need *analysis of the* development of physics teaching materials in the form of interactive E-LKPD based on *iSpring Suite* that is integrated with virtual simulations, identify the weaknesses of conventional teaching materials in target schools, and measure the level of students' independent critical thinking skills as a fundamental foundation in designing effective and relevant instructional products in SMAN X and SMA Y Medan.

RESEARCH METHODS

Place and Time of Research

This research was carried out in two partner schools located in the city of Medan and its surroundings, namely SMAN X and SMA Y in Medan. The two schools are geographically located in the Jalan Wahidin area and its surroundings. The implementation of preliminary study data collection and needs analysis was carried out in the even semester, precisely in May 2026.

Research Design

This research is a descriptive research with a quantitative-qualitative combination approach (*mixed methods*) focused on *need analysis*. The research design of this survey was chosen to objectively photograph and describe the actual conditions of physics learning in the classroom, identify instructional constraints of teachers and students, and analyze the level of urgency of the development of interactive E-LKPD teaching materials based on *iSpring Suite* and virtual simulations. This needs analysis is a fundamental first step in the *framework of Research and Development* (R&D).

Population and Sample

a. Population: The population in this study is all students of grades X and XI who are actively studying Physics subjects as well as teachers who teach Physics subjects at SMAN X and SMA Y in Medan.
b. Sampling: Sampling was carried out using the purposive sampling technique based on the representation of class levels that have different characteristics and experiences of learning physics. The research sample consisted of 2 teachers of Physics subjects and 36 students. Student respondents were spread across two schools, namely SMAN X as much as 54.5% (dominated by class XI MIPA 1) and SMA Y as much as 45.5% (dominated by class X-4).

Research Variables

The variables observed in this needs analysis study include:

a. Actual Conditions of Physics Learning: Patterns of classroom interaction, model application, learning approaches, and utilization of digital media or school facilities (such as projectors).
b. Quality of Existing Teaching Materials: Language readability, visual appeal, saturation level, and the ability of conventional print LKPD in training student learning independence.

c. Students' Cognitive Barriers: Difficulties in memorizing formulas, solving long physics story problems, and numeracy literacy problems.
d. Students' Independent Critical Thinking Level: Ability to analyze, evaluate arguments, and inference physically.
e. Perception of Product Needs: Teachers' and students' interest and response to the urgency of developing an interactive E-LKPD based on *iSpring Suite* and virtual simulations via smartphones.

Research Instruments

Data collection was conducted using a structured questionnaire (questionnaire) instrument that was distributed digitally via *Google Form*. These instruments are divided into two types:

a. Teacher Questionnaire: Consists of closed statements using a Likert Scale of 1–4 (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree) to measure aspects of model planning, scientific approaches, media, and teaching materials. It is also equipped with open-ended questions to explore technical instructional constraints (projector and laboratory facilities) as well as teachers' views on cellphone-based interactive media.
b. Student Questionnaire: Consists of a combination of Likert Scale closed-ended questions to measure saturation levels, the attractiveness of print LKPD, and critical thinking skills. The questionnaire also features open-ended essay questions to identify students' specific difficulties with formulas and story problems.

Data Collection Techniques

The data collection technique used in this study is a non-test survey technique. The data collection process is carried out in stages through the distribution of Google Form questionnaire links directly to physics teachers and representatives of students in grades X and XI at both partner schools during physics or post-learning hours. Photo data of face-to-face activities in the classroom was also collected as evidence of supporting documentation.

RESULTS AND DISCUSSION

Results

Research Results Based on Student Questionnaires

Research data on student perceptions, constraints, and needs was obtained through the distribution of questionnaires to 36 student respondents in two partner schools, namely SMA X (54.5%) which was dominated by class XI MIPA 1, and SMA Y (45.5%) which was dominated by class X-4. All respondents were active students who were studying Physics. Based on the results of the questionnaire data processing, the presentation of the research results is grouped into several main indicators as follows:

1. Students' Perception of the Teaching Materials Used Today

   The condition of printed teaching materials (conventional LKPD) that is currently used in schools is considered to be one of the main triggers for a decline in students' enthusiasm for learning. Based on the questionnaire data graph, the following pattern of student responses was found:

   - Saturation Level: A total of 69.4% of students stated Agree(s) that the LKPD they are currently using makes them bored quickly. The rest of the responses were spread across the Strongly Agree (SS), Disagree (KS), and Disagree (TS) options.
   - Visual Appeal: A total of 66.7% of students found the appearance of the physics teaching materials they used in class to be mediocre or less visually appealing (responding to the statement that the teaching materials were boring/less interesting).
   - Dependence on the Teacher: The majority of students (72.2%) stated Agree(s) that the current LKPD or teaching materials make them always dependent on the teacher's explanation. This shows that the printed LKPD has not been able to stimulate students' independence in constructing their own knowledge.

2. The Biggest Obstacles and Difficulties Students in Learning Physics

   Through open-ended questions about cognitive barriers, students reflect that the complexity of mathematics and the text of the question are the biggest stumbling blocks. The quantitative data highlights several crucial points:

- Difficulty Reading Story Questions: As many as 69.4% of students admitted that they immediately felt confused, lazy, or experienced psychological obstacles when faced with long physics story problems.
- Formula Memorization Patterns: From the results of a qualitative analysis of the question "What is the biggest difficulty you experienced while studying physics?", the largest percentage of students (25%) stated that their main difficulty was memorizing too many formulas and often forgetting how to apply them in the story problem. Other complaints that have arisen significantly include boredom/sleepiness due to monotonous learning, as well as a lack of practicum activities at school.
- Weaknesses of Verbal Explanations: There are as many as 44.4% of students who stated that they Disagree (TS) or Disagree (KS) that the teacher's verbal explanations are enough to make them understand abstract physics material. This strengthens the assumption that the presentation of formulas on the board without the visualization of real phenomena makes it difficult for students to grasp the physical essence of the material.

3. Perception of Interactions and Learning Processes in the Classroom

   Although students faced obstacles in understanding the material independently, the questionnaire data showed a positive response to the teacher's instructional aspects:

   - Clarity and Opportunity to Ask Questions: 75% of students stated that the teacher explained the material clearly, and 61.1% of students agreed that the teacher always gave them the opportunity to ask questions or express their opinions.
   - Contextualization of Learning: As many as 72% of students feel that teachers have tried to connect physics material with daily life.
   - However, when asked about media variations, as many as 47.2% of students stated that they often feel bored during class hours. The trigger is confirmed in the media usage graph, where there is still a lack of use of interactive props or animated videos (only around 63.9% for the response of general agreement, but often constrained by school facilities).

4. Need Analysis for E-LKPD and Virtual Simulation

   As a solution to break the chain of learning saturation, the questionnaire measures students' interest and preference for digital gadget-based media (HP):

   - Interest in Visual Media: 58.3% of students stated that physics learning would be much easier to understand and interesting if the teaching materials were equipped with video visualizations, moving images, or interactive simulations.
   - Desire for Future Learning Methods: From the pie chart regarding "What kind of media or way of learning do you want?", students' answers are evenly distributed (10% each) on multimedia components, such as: the existence of integrated explanatory videos, digital-based teaching materials/accessible on cellphones, the existence of clear visual illustrations, the availability of interactive question analysis, and the existence of online practicum/simulation methods.
   - Acceptability of the Use of E-LKPD: The level of urgency of the development of this product is absolutely validated through a diagram of student interest. As many as 69.4% of students stated "Yes/Interested" to use interactive E-LKPD in learning fisika Next. The most rational reason they conveyed was the practicality factor (because it can be accessed flexibly via their smartphones), the dynamic display is believed to reduce boredom, as well as help them conduct self-simulations anywhere without the limitations of the classroom.

Research Results Based on Teacher Questionnaires

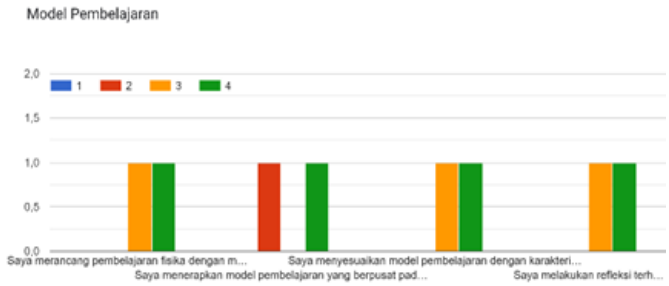


Figure 1. Questionnaire on Learning Models

Teachers showed real effort in designing and reflecting varied physics learning models in the classroom, where their responses were on a scale of 3 (Frequently) and 4 (Always) for aspects of model variation, suitability with student characteristics, and commitment to conducting post-learning reflection. However, a paradox arises in the aspect of learning orientation, especially in the statements related to the application of the student-centered model. At this point, the teacher's answer is split in the extreme where one teacher chooses a scale of 4 (Always) while the other teacher is on a scale of 2 (Sometimes), which reflects the existence of an unequal capacity or constraint in the field in fully unleashing the conventional method.

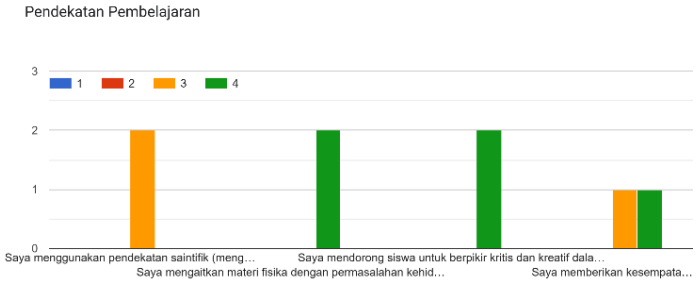


Figure 2. Questionnaire on Learning Approaches

In transferring material as well as stimulating students' mindsets, the two teachers have compactly applied a scientific flow of thinking on a regular basis as evidenced by the choice of a scale of 3 (Frequent) in the application of scientific approaches. Maximum success was achieved in the aspect of contextualizing phenomena and stimulating critical thinking, where the two teachers compactly chose a scale of 4 (Always) to try to relate physics material to daily life and encourage students to think critically and creatively in solving problems. Meanwhile, regarding the provision of freedom of opinion and choosing the appropriate learning method for students, the distribution of teachers' responses remains in a good category, namely on a scale of 3 and a scale of 4.

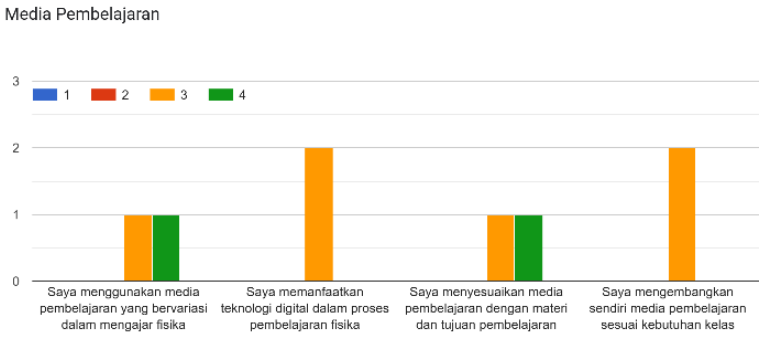


Figure 3. Questionnaire on Learning Media

The use of technology and the variety of teaching aids by teachers shows a positive trend but is still hit by limitations of facilities, as can be seen from the distribution of responses on scales 3 and 4 on the aspect of media variation and the suitability of the media with learning objectives. In the use of digital technology, the two teachers compactly chose a scale of 3 (Frequently), which is directly correlated with their qualitative complaints about the limitations of physical facilities in schools. Another interesting thing is the ability to develop independently, where the two teachers are compact on a scale of 3 for making their own media, indicating the limitation of space, time, or instruments to create original interactive media.

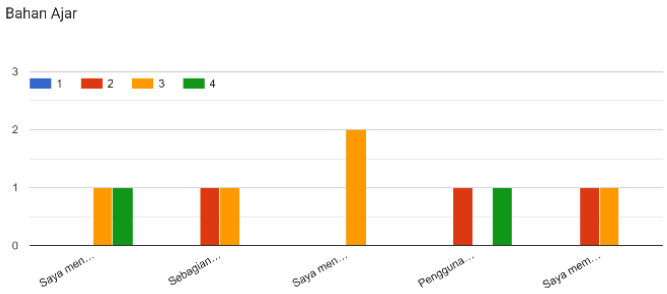


Figure 4. Questionnaire On Teaching Materials

Evaluation of the quality of the modules and physical LKPD currently shows that there is an urgent need for updates, even though teachers have tried to adapt the teaching materials to the characteristics of the students (scale 3 and 4) and provide examples of real applications (compact scale 3). The fundamental problem can be seen in the level of language readability and the impact of student boredom, where one of the teachers chose a scale of 2 (Disagree) which confirms the existence of acute student saturation of conventional LKPD. The low response of teachers to the aspect of student independence (scales 2 and 3) is strong empirical evidence that the current printed teaching materials fail to support the independent learning process, so the development of interactive E-LKPD is a very urgent solution.

Teacher Interview Results

1. What learning media is often used in teaching physics? How do you choose it?
   - Books and the Internet
   - The media I use depends on what material is taught and more often shows real props and simple practicums.
2. Do you use modules or LKPD in learning? What is the development process?
   - Varies and is developed according to the student's condition
   - Yes, I use modules or LKPD and the development process I adjust to the material and also the abilities of the students
3. What obstacles do you often face in the process of implementing physics learning?
   - Students' understanding of the concept and basis of superficial calculations
   - Time is sometimes lacking in the learning process and students are less interested in expressing their opinions.
4. What needs to be improved in the process of learning physics at this school according to you?
   - Understanding of physics and mathematics concepts
   - More adequate facilities and infrastructure
5. What is the biggest obstacle that you face in learning physics in the classroom?
   - Lack of willingness of students
   - The obstacle is that the projector is minimal so that to use the tool you have to scramble with other teachers
6. What kind of media or teaching materials do you think are needed in learning physics today?
   - Interactive media
   - Interesting media or teaching materials that may be accessible using cellphones
7. What do you think about the use of E-LKPD in physics learning?
   - Pretty good and developed
   - I think the use of E-LKPD can help increase students' interest in learning physics
8. Why do you think some students still have difficulty understanding physics?
   - There is still a lack of understanding of application in daily life2
   - Because of the lack of willingness from within students to learn physics and the lack of various learning models that I made.

Discussion

The process of learning physics at the high school level in the era of the modern curriculum requires a fundamental transformation, from *teacher-centered* to *student-centered*. Based on empirical investigations conducted through the distribution of questionnaires to physics teachers and students at two partner schools, namely SMAN 18 Medan and Private High School PAB 8 Saentis

found various dynamics, gaps, and great potentials related to the implementation of digital learning media. The in-depth discussion of the results of this research is grouped into the four analytical pillars below.

Analysis of Learning Models and Approaches: The Paradox Between Teachers' Pedagogical Intentions and Students' Cognitive Readiness

Based on the response data of physics teachers' questionnaires, there is a strong indication that educators at partner schools have high pedagogical awareness. Teachers stated that they consistently designed physics learning with varied models, applied a *student-centered* approach, used scientific methods (observing, questioning, trying, reasoning, and communicating), and sought to encourage students' critical-creative thinking skills. Teachers are also committed to always associating physical phenomena with real problems in daily life so that learning becomes more meaningful.

However, when the data from the teacher's perspective is confronted with the real data of the students' responses recorded in the student questionnaire, a fairly sharp learning paradox emerges:

1. Limitations of Verbal-Conceptual Comprehension where even though the teacher feels that he has given the clearest explanation possible, quantitative data shows that 44.4% of students stated that they did not agree or hesitated that the teacher's way of teaching verbally could directly make them understand the material. This indicates that the delivery of abstract physics material cannot rely on one-way lecture or explanation methods, but requires a concrete visual bridge.
2. Weakness in Cognitive Independence where the teacher describes in the main obstacle is that the level of willingness of students to explore learning independently is still very lacking. When students are faced with situations to discover concepts independently, they tend to get stuck due to a fragile conceptual foundation.
3. Low Numeracy Literacy and Question Analysis Ability where this phenomenon is clearly confirmed through student questionnaire data, where 69.4% of students admitted to experiencing great difficulty and confusion when reading long story questions. In terms of qualitative, when asked about "What is the biggest difficulty you experienced while studying physics?", the majority of students gave the same answers, such as "if you are given a story, you are still confused", "memorize many formulas", "forget formulas", and "often forget when using formulas".

This condition shows that there is a distortion between the expectations of the curriculum that wants students to think at a higher level (Higher Order Thinking Skills / HOTS) and the reality of mathematical skills and students' understanding of basic concepts recognized by teachers is still very shallow. Students are trapped in a mechanistic learning pattern (memorizing formulas without understanding their physical meaning), so when the type of question is transformed into a story form or contextual analysis, they immediately experience psychological and cognitive obstacles.

Analysis of Media and Conventional Teaching Materials to Uncover the Root Causes of Physics Learning Saturation

One of the most crucial findings in this study is the high level of student saturation of physics learning activities in the classroom. Quantitative data shows that 33.3% of students openly admit that they often feel bored during the physics learning process. Through the open-ended question instrument on "What do you think makes learning physics less interesting?", students expressed complaints such as "boring learning", "too many formulas and calculations", "lack of learning media", and "lack of practical media".

The root causes of this high rate of saturation and low student interest can be traced to two main interrelated factors:

1. The Monotonous Nature of Teaching Materials (LKPD): Student Worksheets (LKPD) or printed teaching materials used in schools today are considered to fail to be a learning stimulator. It is evident from the questionnaire data, as many as 69.4% of students stated that the LKPD they are currently using makes them bored quickly. The structure of the conventional LKPD generally contains only a concise summary of the formula, followed by a series of theoretical practice questions without any representative visualization. This is exacerbated by the assessment of 66.7% of students who consider the appearance of physics teaching materials in their classrooms to be mediocre or less visually appealing.

2. Limited School Facilities and Infrastructure: Student complaints regarding the lack of media and practicum were honestly confirmed by the teacher. The teacher explained that the main obstacle in the field is the limited technology facilities, one of which is the lack of projector equipment in schools so that teachers have to compete with other teachers to use them. The limitations of projectors result in the infrequent showing of videos visualizing natural phenomena, while real school laboratories are also not able to facilitate practicum for modern or abstract materials that require high precision. The limited time in lesson hours also makes conventional practicum activities often incomplete or rushed.

This cause-and-effect relationship forms a circle: School facilities are limited → Teachers struggle to present interactive visual media → Teaching materials rely on monotonous printed LKPDs→ Students are forced to memorize formulas mechanically → Students are bored, sleepy, and consider physics to be a scary subject.

The Urgency of Developing Digital-Based Interactive E-LKPD

To break the chain of learning saturation, the results of data analysis from both parties (teachers and students) point to the same solution, namely the reconstruction of conventional teaching materials into interactive digital teaching materials that are rich in visual features.

When students were asked to give aspirations about "What kind of media or way of learning do you want?", their response was very narrow on multimedia-based media. They want learning that is "included with videos", "digital with clear presentations", "there are practices/illustrations", and "there is a dissection of the questions". This desire is strengthened by quantitative data where 58.3% of students stated that they are very interested if teaching materials are equipped with image/video visualization, and they believe that the existence of visual media will make it easier for them to construct concept understanding independently.

The potential for successful implementation of digital media in the classroom is reinforced by the fact that 69.4% of students explicitly stated "Yes/Interested" to use interactive digital LKPD in their physics learning. The reasons expressed by the students are very logical and based on ease of access, such as "because using a cellphone becomes more practical", "easy to understand", and "it becomes less boring". The characteristics of generation z who are attached to gadgets can be used positively by shifting the focus of playing gadgets to interactive learning media.

On the other hand, the physics teachers gave the green light and full support to this plan. The teacher stated that the use of E-LKPD which is interesting and can be accessed flexibly using each student's smartphone is the most effective solution. This media is considered effective to boost interest as well as train students' independent learning independence in the midst of the limitations of projectors and real laboratory equipment in schools.

Integration of iSpiring Suite Authoring Tools and Virtual Simulation in E-LKPD as a Modern Comparative Solution

The development of interactive E-LKPD in this study is not just about converting the print medium into a static digital sheet (like a regular PDF format). More than that, E-LKPD is designed as an adaptive learning ecosystem through the integration of Virtual Simulation technology and material packaging using *the iSpring Suite authoring tool software*. This revolutionary step is targeted to be able to unravel all the complexities of upstream-downstream problems faced by teachers and students at SMAN 18 Medan and Private High School PAB 8 Saentis.

As recorded in the questionnaire data, the limitation of physical facilities is the main stumbling block for teachers. Concrete problems such as the lack of projector equipment that makes teachers have to fight with each other, as well as the limited number of real laboratory equipment for abstract materials, have been structurally overcome through virtual simulations embedded directly in *the interactive format of iSpring Suite*.

Through the use of *iSpring Suite* and Virtual simulations, several specific solutions have been successfully presented to solve the learning problems that have been identified, namely:

1. Interactive and Independent Evaluation System (Overcoming Formula Memorization Obstacles) In the student questionnaire, it was found that 69.4% of students had difficulty reading story questions and the majority were stuck in a mechanistic learning pattern (memorizing formulas). *iSpring Suite* provides the iSpring Quiz Maker feature that allows researchers to design a rich variety of questions—such as drag and drop, matching pictures, to graded question types—that are complemented by instant feedback. When students misenter concepts or mathematical logic

calculations, *the iSpring* system will immediately display physical clues (scaffolding) instead of just blame. This trains students' cognitive independence and transforms memorization habits into a deep understanding of concepts.

2. Multimedia Synchronization Without Space and Screen Limits (Overcoming Projector Limitations) Teachers' complaints about the lack of projectors in the classroom are eliminated with the comparative advantage of *iSpring Suite* which is able to convert PowerPoint materials into responsive HTML5 format. This means that all videos explaining natural phenomena, animations, and virtual practicum web links can be accessed seamlessly directly from each student's smartphone (HP). Students are no longer passive spectators in the back of the classroom who have trouble seeing a limited single projector screen, but rather become active operators at their own desks using Z-Generation-friendly gadgets.
3. The Structured Virtual Laboratory Integration Container Web *Object feature* in *the iSpring Suite* allows researchers to embed web-based virtual simulations (such as PhET Simulation) directly into the E-LKPD page without forcing students to leave the teaching material application. This answers the students' complaints about the "lack of practical media". In abstract modern physics materials (such as photoelectric effects, atomic motion, or quantum mechanics), students can change the experimental variables and directly see their dynamic visualizations in this E-LKPD made by iSpring. This digital sensory experience runs in succession with structured scientific work guides, helping students to do logical reasoning independently.

Thus, the combination of *iSpring Suite* as a teaching material packaging platform and Virtual Simulation as the experimental content creates an interactive E-LKPD that is independent, practical, and anti-boring. The use of this technology is empirically urgent to be implemented in order to break the vicious cycle of saturation of studying physics in target schools.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that there is a real gap between teachers' pedagogical intentions in implementing student-centered learning and students' cognitive readiness which is still hampered by weak numeracy literacy and high levels of saturation due to monotonous conventional teaching materials. The limitations of the school's physical facilities, such as the lack of projectors, exacerbate this situation so that the visualization of abstract physics concepts cannot be conveyed optimally. As a solution, the development of interactive E-LKPD that integrates Virtual Simulation technology has proven to be empirically urgent and needed; Virtual simulation technology is able to decentralize the physical laboratory directly to students' devices to break down the limitations of facilities and act as an adaptive personal tutor who guides students out of the shackles of memorizing formulas and difficulty solving story problems, so that it is cumulatively able to boost interest, independence, and reduce the saturation rate of learning physics.

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