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THE DEVELOPMENT OF AN E-WORKSHEET WITH A SCIENTIFIC APPROACH TO IMPROVE STUDENTS' LEARNING OUTCOMES AND QUESTIONING SKILLS IN SCIENCE EDUCATION AT ELEMENTARY SCHOOLS

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ABSTRAK

Abstrak: Penelitian ini dilakukan berdasarkan hasil observasi diperoleh kemampuan bertanya dan hasil belajar IPA siswa di SDN Gebang 03 masih rendah. Salah satu upaya untuk menatasi permalsahan tersebut dibutuhkan media pembelajaran multimedia yang sesuai dengan kebutuhan siswa era digital. Peneliti dalam hal ini mengembangkan e-worksheet berbasis pendekatan saintifik dalam pembelajaran IPA. Tujuan penelitian ini adalah untuk mengembangkan e-worksheet berbasis pendekatan saintifik dengan pendekatan saitifik dalam pembelajaran IPA yang valid, praktis, dan efektif. Jenis penelitian ini adalah R&D menggunakan model ADDIE dengan subjek penelitian adalah semua siswa kelas VI di SDN Gebang 03 Kecamatan Patrang Kabupaten Jember. Hasil penelitian menunjukkan bahwa kevalidan silabus, RPP, e-worksheet, bahan ajar, tes hasil belajar diperoleh kategori nilai modus 4 yang berkategori sangat valid. Kepraktisan e-worksheetberbasis pendekatan saintifik berdasarkan hasil penilaian tiga observer pada dua kelas menyatakan bahwa e-worksheetyang dikembangkan sangat praktis dengan berada pada 98,82%. Keefektifan E-LKPD berbasis pendekatan saintifik berdasarkan hasil N-Gain yang diperoleh dari pre-test dan post-test diperoleh kategori tinggi, sehingga dapat dinyatakan bahwa E-LKPD berbasis pendekatan saintifik dinyatakan efektif digunakan dan dapat meningkatkan keterampilan bertanya dan hasil belajar siswa.

Abstract: *This study was conducted based on the results of observations obtained that the ability to ask questions and science learning outcomes of students at SDN Gebang 03 were still low. One effort to overcome this problem requires multimedia learning media that is in accordance with the needs of students in the digital era. Researchers in this case developed e-worksheets based on a scientific approach in science learning. The purpose of this study was to develop e-worksheets based on a scientific approach with a scientific approach in science learning that is valid, practical, and effective. This type of research is R&D using the ADDIE model with the research subjects being all sixth grade students at SDN Gebang 03, Patrang District, Jember Regency. The results showed that the validity of the syllabus, lesson plans, e-worksheets, teaching materials, and learning outcome tests obtained a category of mode 4 which is categorized as very valid. The practicality of e-worksheets based on a scientific approach based on the assessment results of three observers in two classes stated that the e-worksheets developed were very practical at 98.82%. The effectiveness of E-LKPD based on a scientific approach based on the N-Gain results obtained from the pre-test and post-test obtained a high category, so it can be stated that E-LKPD based on a scientific approach is effective to use and can improve students' questioning skills and learning outcomes.*

A. BACKGROUND

The scientific approach is one method that can be applied in science education. This approach begins with the observation of natural phenomena around us, which fosters curiosity and the desire to learn through scientific inquiry (Andikalan et al., 2022; Maulidina et al., 2018; Suryaman & Ningsih, 2021). This learning process encourages students to actively participate, which can enhance their questioning skills due to the interactions between teachers and

students, as well as among students (Safitri et al., 2022). Sudarmanti et al. (2020) state that the more a person practices asking questions, the more their curiosity develops. When students ask questions, they tend to focus more on the material being studied and seek answers to things they don't understand (Kalsum et al., 2021). The questions posed help students achieve a better learning experience. The questions asked by students during learning can improve the quality of the learning process.

One of the competencies that students must master in the scientific approach is the skill of asking questions. In this activity, creativity, curiosity, and critical thinking can be developed through question formulation (Pratiwi et al., 2019; Wahono et al., 2022). Asking questions is a verbal action that requires a response from others (Kusuma et al., 2023). This response can range from information to considered outcomes. Therefore, asking questions is an effective stimulus to improve thinking abilities. Questioning skills can also enhance students' thinking abilities and allow them to acquire more knowledge during the learning process (Fuadina et al., 2022; Meldina, 2019). Overall, questioning is a way to communicate ideas and thoughts through questions.

The questions posed by students can be used to analyze and explore ideas. Spontaneous questions from students can stimulate them to think, discuss, and speculate (Khusniati, 2012). The questions asked by students can be considered feedback on the lesson delivered by the teacher. Questioning skills are important for students because they are indicators of students' understanding of the lessons provided by the teacher (Siswantoro, 2020). student's ability to ask questions also reflects their critical thinking skills (Nasihah et al., 2020). Cognitively, asking questions indicates that a person has thought (Surya, 2020). However, several studies show that students' questioning skills are still low. Students often have difficulty asking questions about the topics being studied (Hafizo et al., 2022; Kalsum et al., 2021; Prilanita & Sukirno, 2017). Utami et al. (2015) shows that teachers ask more questions than students. Another study by (Royani & Muslim, 2014) shows that although there has been an improvement in the quality of students' questions, the number of students asking questions is still limited.

Observations and interviews conducted in classes VIA and VIB at SDN Gebang 03, Jember, with 56 students and 2 teachers, showed that science education in the class has not fully facilitated students in developing their questioning skills. Students tend to be passive, and the opportunity to ask questions is mostly used at the end of the lesson. Not all students take advantage of this opportunity, and many find it difficult to ask questions because they do not fully understand the material being taught. This affects the students' self-confidence in asking questions, especially when they don't understand the science material being taught, and ultimately affects their science learning outcomes.

Several previous studies have attempted to find solutions to address the low questioning skills of students, one of which is through the use of Student Worksheets (LKPD) Putriyana et al. (2020) explain that LKPD serves as a guide to help students understand the lesson material. The sequence of activities in the LKPD is designed to maximize students' understanding of the learning objective. Studies by Susilowati & Ramli (2017) emphasizes the importance of research to improve students' questioning skills, especially in elementary schools.

Learning materials in schools are generally still conventional, such as LKPD and printed books (Tita et al., 2019). This could indicate a lack of learning materials, media, and learning resources (Asma, 2020). This also indicates the ineffectiveness and low efficiency of the teaching materials being used (Syafitri, 2020). More innovative LKPD, in the form of electronic worksheets (e-worksheets), are needed to support more efficient learning (Hidayah et al., 2020). The use of electronic teaching materials such as e-worksheets helps students who find it difficult to carry many printed books(Sriwahyuni et al., 2019). Some students find it difficult to bring multiple textbooks, especially when there are several subjects in one day. Therefore, interactive and innovative teaching materials are required to facilitate learning. An e-worksheet specifically designed with a scientific approach can help students develop intellectual skills. Through e-worksheets, students' process skills can be stimulated, such as high-level questioning skills, seeking information, investigating, and solving problems. Questioning and critical thinking skills are very important in the 21st century, and educators agree that the development of these skills is a key element in the education system. E-worksheets with a scientific approach also emphasize the development

of students' intellectual skills, including higher-level questioning skills (Zahara et al., 2021).

Previous research has shown that e-worksheets have a positive impact on increasing students' motivation and learning outcomes in science education. Information technology in education allows students to learn in more engaging ways that meet their needs (Widodo & Haris, 2021). Based on previous research, this study differs by integrating the interactive aspects of Canva with the scientific stages. This is intended to support the crucial questioning skills for the development of deep conceptual understanding in science, as well as improve students' learning outcomes. In addition to learning outcomes, this study also emphasizes students' questioning skills, which support students in actively participating in scientific processes, asking critical questions, and thinking analytically. The goal of this research is to develop a valid, practical, and effective e-worksheet based on the scientific approach for science education.

B. RESEARCH METHODOLOGY

This research and development of the e-worksheet based on the scientific approach uses the ADDIE model. This e-worksheet development research used the ADDIE model. This model is known for its systematic approach to designing educational products and testing their effectiveness (El Widad et al., 2023). ADDIE was chosen because of its structured phases that address learning problems by creating appropriate learning resources (Novanda et al., 2024). This model produces comprehensive and rational learning materials for both short-term and long-term use (Filjinan et al., 2022). The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation.

The first stage is analysis, which aims to identify learners' needs through needs analysis, problem identification, and task analysis (Istighfarini et al., 2022). In this stage, learning objectives, achievement indicators, and assessments are determined. Data was collected through observation and interviews with sixth-grade teachers at UPTD Satuan Pendidikan SDN Gebang 03.

The second stage is design, which involves creating the physical design of the teaching materials, determining the target users, specifying what needs to be learned, and how student performance will be assessed. During this stage, the initial e-worksheet draft was compiled, including lesson material, assignments, and activity steps.

The third stage is development, which involves creating the product based on the design. The materials were gathered, illustrations made, and the e-worksheet compiled and validated by education experts. After revisions, the e-worksheet was tested on sixth-grade students at UPTD Satuan Pendidikan SDN Gebang 03.

The fourth stage is implementation, involves applying the e-worksheet in the classroom to determine its practicality and effectiveness. The trial was conducted in VIA and VIB classes at UPTD Satuan Pendidikan SDN Gebang 03.

The final stage is evaluation, which aims to improve the e-worksheet based on feedback from students and teachers and to assess student learning outcomes after using the product.

This research and development of the e-worksheet was conducted at UPTD Satuan Pendidikan SDN Gebang 03, located on Jl. Manggar No. 152, Gebang Village, Patrang Subdistrict, Jember Regency, East Java. The research took place in March 2023 during the second semester. The study involved students from classes VIA and VIB at UPTD Satuan Pendidikan SDN Gebang 03 for the 2022/2023 academic year. Class VIA consisted of 28 students, and class VIB also had 28 students. These classes were chosen because they had similar academic abilities based on preliminary research observations.

The instruments used in this study included validation sheets, observation sheets, and learning outcome tests to measure the effectiveness and practicality of the e-worksheet. The validation sheets were completed by science learning experts, assessing the e-worksheet's content alignment, suitability for student development, language, graphics, and effectiveness. Observation sheets of learning implementation were used to provide an overview of the practicality of the e-worksheet in the learning process. The observation sheets for questioning skills included elements of scientific learning, such as problem analysis, focusing on the problem, information seeking, problem communication, opinion sharing, appreciating opinions, offering alternative solutions, and choosing the right solution for problem-solving. The learning outcome test instrument is implemented after the use

of the initial product and also after the use of the revised new product. The average results of both tests are calculated and then confirmed in the effectiveness comparison table.

The validation data from two validators, including their checklist results and suggestions during the validation of the developed worksheet product, are analyzed to calculate the average validation score from both validators. Akbar (2017) states the formula for validity as follows:

$V\text{-}_{ah} = \frac{Tse}{Tsh} x\ 100$

In this formula:

$V-ah$ = E-Module Validity

Tse = Total empirical score achieved

Tsh = Total maximum score

Next, the total validity score $V-ah$ is referenced to determine the validity level within the specified interval. The criteria for validity levels can be seen in Table 1 below

Table 1Validity Criteria

No	Validity Criteria	Validity Level
1	0% < $V-ah$ ≤ 100%	Very valid or can be used without improvements
2	60% < $V-ah$ ≤ 80%	Valid enough or can be used with minor improvements
3	40% < $V-ah$ ≤ 60%	Less valid, recommended not to use due to need for major improvements
4	20% < $V-ah$ ≤ 40%	Not valid or should not be used
5	0% < $V\text{-}ah$ ≤ 20%	Very invalid – should not be used

The practicality data is analyzed descriptively based on the observation scores provided by the experts. The practicality data was obtained through an observation sheet filled out by the observers. The practicality data for the use of E-LKPD is analyzed in percentage (%), using the following formula:

Practicality Score = $\frac{Total\ score\ obtained}{Total\ maximum\ score}$ x 100%

After obtaining the percentage result, Purwanto (2012) categorized the practicality criteria as modified below:

Table 2. E-LKPD Practicality Assessment Criteria

Percentage Score	Category
86% - 100%	Very Practical
76% - 85%	Practical
60% - 75%	Quite Practical
1 % - 54%	Not Practical

The effectiveness data is analyzed using N-Gain based on the scores from the pretest and posttest to assess the effectiveness of using E-LKPD. The N-Gain test is conducted to determine the effectiveness of using E-LKPD. The gain score is calculated using the normalized gain formula as follows (Meltzer, 2002):

$\langle g \rangle = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{100\% - \langle S_{pre} \rangle}$

In this formula:

$\langle g \rangle$: gain factor

$\langle S_{pre} \rangle$: average pretest score (%)

$\langle S_{post} \rangle$: average posttest score (%)

Table 3. Criteria for Gain Factor ⟨g⟩

Gain Factor$\langle g \rangle$	Criteria
$\langle g \rangle \geq 0,7$	High
$0,3 \leq \langle g \rangle < 0,7$	Medium
$\langle g \rangle < 0,3$	Low

C. RESULTS AND DISCUSSION

This development research aimed to measure the validity, practicality, and effectiveness of the scientifically-based e-worksheet developed. This development was intended to improve students' questioning skills during lessons and maximize their learning outcomes. The e-worksheet, designed with a scientific approach, allowed students to be more active in exploring the subject matter through critical thinking and investigation. This scientifically-based e-worksheet was designed to optimize students' learning experiences through creative, user-friendly visual elements (Yusnarti et al., 2022).

Development research was conducted to determine the validity, practicality, and effectiveness of the e-worksheet product based on the scientific approach developed by the researcher. This e-worksheet, based on the scientific approach, was designed to optimize students' learning experiences through creative and user-friendly visual elements (Nurhayati, 2022). The development of this e-

worksheet, based on the scientific approach, follows the ADDIE model with the following procedures:

1.*Analyze*

The needs analysis was conducted to identify the causes of the problems arising in the science learning process in elementary schools, specifically in the topic of animal and plant adaptation to their environment. In this phase, the researcher conducted observations and interviews regarding the teaching materials currently used by the sixth-grade teacher to improve students' questioning skills and learning outcomes. The results of the observations and interviews showed that the teacher had not optimally developed e-worksheets and only used conventional worksheets provided by the publisher. As a result, the learning process could not fully facilitate students in achieving the learning objectives. The researcher also conducted an analysis of the students' characteristics as a basis for developing an e-worksheet that is suitable for the students' characteristics with the aim of improving students' learning outcomes and questioning skills. Generally, sixth-grade students are 11-12 years old. At this age, according to Piaget, students' intellectual development is at the formal operational stage, where they can think logically, rationally, and even abstractly

2. ***Design***

The development of the e-worksheet refers to the current curriculum, where the role of digital technology in education, such as Canva, plays an important role in responding to the challenges of the digital era. In the context of e-worksheet development, the Canva application provides various features to design interactive and visually appealing worksheets. The scientific-based e-worksheet can be accessed on various digital devices, allowing students to learn more independently and flexibly (Kurniawan, 2021). The e-worksheet designed with a scientific approach allows students to be more active in exploring the lesson content through critical and investigative thinking. The use of Canva in the development of e-worksheets enables the creation of visually engaging worksheets that support the scientific steps effectively. Canva, as a design platform, allows teachers to create worksheets that are tailored to learning needs, including visual designs that facilitate the understanding of complex concepts. This scientific-based e-worksheet is designed to optimize the students' learning experience through creative and user-friendly visual elements (Nurhayati, 2022).

Figure 1. Design of the e-worksheet created with the Canva application.

3. *Develop*

The assessment of the validation of the e-worksheet based on the scientific approach by education experts is a crucial step in evaluating the quality of the developed product. This validation includes assessments of various aspects, such as content feasibility, the alignment of the material with the scientific approach, the effectiveness of the media, and the integration of other components that support the learning process. Through this evaluation, a clear understanding of the strengths and weaknesses of the product is obtained, enabling further improvements to be made (Fatma et al., 2024; Lubis et al., 2021). Through the feedback from the validators, it is expected that the e-worksheet will support achieving more effective, interactive learning objectives and align with curriculum standards. Furthermore, the results of the validation of the developed product are presented in Table 4.

Table 4. E-Worksheet Validation Results.

Validation component	Validation Score	Criteria
Content Suitability	93,80	Highly Valid
Suitability for student development	91,70	Highly Valid
Language and graphics	88,90	Highly Valid
Usage effectiveness	91,70	Highly Valid

Table 4 shows the validation results of the e-worksheet with a scientific approach by validators. The content alignment received a score of 93.80, classified as highly valid, indicating that the e-worksheet's content is highly relevant and aligns with the learning objectives. The e-worksheet is also suitable for student development, with a score of 91.70, categorized as highly valid. This suggests that the e-worksheet has been designed to optimally support the development of students' skills and potential. The language and graphics aspect received a score of 88.90, falling into the highly valid category, demonstrating clear, easy-to-understand, and engaging language use and visual elements. The effectiveness of use scored 91.70, indicating that the e-worksheet is highly effective in supporting an interactive learning process that meets the students' needs. Overall, the validation results indicate that the e-worksheet product is excellent and suitable for improving questioning skills and learning outcomes. One feature of the e-worksheet that directs students to develop questioning skills is shown in Figure 2.

Figure 2. Questioning Skills Feature

Based on the observation of the use of the e-worksheet with a scientific approach, it provides an overview of how effectively this learning tool is implemented in the classroom. The observation covers aspects of the learning process, such as alignment with the scientific approach, student engagement, teacher-student interaction, and the effectiveness of the product in supporting active and meaningful learning (Hidayah et al., 2020).

Based on the results of the observation, it can be assessed whether the e-worksheet supports the expected learning goals and provides insights into areas that need improvement or strengthening. Therefore, the observational data serves as a foundation for evaluating the quality and success of using the e-worksheet.

4. Implementation

The developed e-worksheet product with a scientific approach was trialed at UPTD Satuan Pendidikan SDN Gebang 03, Patrang District, Jember Regency, during the 2022/2023 academic year. The VIA class consisted of 28 students, and the VIB class also had 28 students. The trial was conducted over six meetings in each class, during which the developed e-worksheet was used, along with pre-tests before learning and post-tests after the learning sessions.

The results of the practicality test of the e-worksheet with a scientific approach, based on classroom observations in classes VIA and VIB, provided valuable insights into the use of the e-worksheet within the classroom context. The observations reflected the interaction between the teacher and students, as well as how the e-worksheet enhanced student engagement in the learning process (Sari et al., 2022). The e-worksheet was able to facilitate understanding of the material, stimulate curiosity through questioning, and encourage students to think critically. Based on observations in both classes, a clear picture was obtained regarding the strengths and challenges in the implementation of the e-worksheet, as well as recommendations for further development of the technology-based product and the scientific approach. Furthermore, the results of the observation on the implementation of learning using the e-worksheet based on the scientific approach are presented in Tables 5 and 6 below.

Table 5. Learning Implementation in Class VIA

Meeting	Introduction Activity		Main Activity		Closing Activity	
	Score	Criteria	Score	Criteria	Score	Criteria
1	97,5	Very Practical	82,7	Practical	100	Very Practical
2	81,25	Practical	90,38	Very Practical	100	Very Practical
3	90,91	Very Practical	94,23	Very Practical	100	Very Practical
4	100	Very Practical	96,15	Very Practical	100	Very Practical

5	100	Very Practical	90,38	Very Practical	100	Very Practical
6	100	Very Practical	98,08	Very Practical	100	Very Practical

Table 6. Learning Implementation in Class VIB

Meeting	**Introduction Activity**		**Main Activity**		**Closing Activity**	
	Score	**Criteria**	**Score**	**Criteria**	**Score**	**Criteria**
1	97,5	Very Practical	94,23	Very Practical	100	Very Practical
2	81,25	Practical	94,23	Very Practical	100	Very Practical
3	97,51	Very Practical	82,69	Very Practical	100	Very Practical
4	97,5	Very Practical	90,38	Very Practical	100	Very Practical
5	97,5	Very Practical	94,23	Very Practical	100	Very Practical
6	97,5	Very Practical	98,08	Very Practical	100	Very Practical

The data in Tables 5 and 6 show the results of the learning implementation in classes VIA and VIB during six meetings, focusing on three main activities: the introductory activity, the core activity, and the closing activity. In both class VIA and class VIB, the introductory activities showed excellent results with practical and very practical criteria. This indicates consistency in preparing students before moving on to the core activities. The core activities in both classes also showed scores ranging from practical to very practical categories. This demonstrates the success in applying the appropriate and engaging learning process, encouraging students to become more actively involved in the lessons (Mahsup et al., 2023). Similarly, the closing activities in both classes received scores within the very practical criteria in all meetings. This indicates that the learning process was concluded effectively and well in both classes. Overall, while both classes demonstrated good implementation of the lessons with a dominant "very practical" criterion, class VIB was more consistent during the introductory activities, while class VIA showed significant progress in the core activities as the meetings progressed. This reflects the importance of adapting and responding to the dynamics of learning in different contexts.

5. *Evaluate*

At this stage, the effectiveness of using the e-worksheet with a scientific approach in classes VIA and VIB was tested to assess its impact on students' questioning skills. The research product in the form of the e-worksheet was able to stimulate students' ability and curiosity to ask critical and analytical questions. By using a scientific approach, the learning process not only presents information but also encourages students to remain active and engaged in the learning process, interact with the material, and practice developing relevant questions (Muhammad et al., 2020). The results of this test provide insights into the effectiveness of the e-worksheet in enhancing students' questioning skills, as well as offering recommendations for the development of more innovative and interactive teaching methods in the future. The assessment results of the questioning skills are shown in Tables 7 and 8.

Table 4. Students' Questioning Skills in Class VIA

Data Component	**Meet. 1**	**Meet. 2**	**Meet. 3**	**Meet. 4**	**Meet. 5**	**Meet. 6**
Number of Students	31	31	31	31	31	31
Highest Score	83,33	100	100	100	100	100
Lowest Score	16,67	33,33	58,33	50	66,66	66,67
Average	56,99	68,55	77,42	82,53	87,90	98,82
Standard Deviation	0,17	0,23	0,18	0,21	0,11	0,09
N-Gain	-	**0,49**	**0,65**	**0,73**	**0,87**	**0,94**
Criteria	-	**Medium**	**Medium**	**High**	**High**	**High**

Table 5. Students' Questioning Skills in Class VIB

Data Component	**Meet. 1**	**Meet. 2**	**Meet. 3**	**Meet. 4**	**Meet. 5**	**Meet. 6**
Number of Students	30	30	30	30	30	30
Highest Score	75,00	100	91,67	100	100	100
Lowest Score	41,67	33,33	58,33	33,33	58,33	66,67
Average	59,72	55, 28	75,83	78,61	82,22	86,94
Standard Deviation	0,14	0, 14	0,15	0,22	0,13	0,14
N-Gain	**-**	**0,49**	**0,59**	**0,63**	**0,82**	**0,94**
Criteria	**-**	**Medium**	**Medium**	**Medium**	**High**	**High**

Data in Tables 7 and 8 show an improvement in students' questioning skills in both classes VIA and VIB after the implementation of the e-worksheet with a scientific approach. In class VIA (Table 4), the data reflects an increase in students' questioning skills. The average score increased from 56.99 in session 1 (P1) to 98.82 in session 6 (P6). This improvement is also reflected in the N-Gain score, which increased from 0.49 (moderate) in session 2 (P2) to 0.94 (high) in P6. This indicates that the use of the e-worksheet

gradually and effectively improved students' questioning skills.

For class VIB (Table 5), although the average initial score in P1 was 59.72, there was an increase to 86.94 in P6. While the N-Gain scores in P2, P3, and P4 were in the moderate category, the improvement in P5 and P6, with N-Gain scores of 0.82 and 0.94, shows that the e-worksheet began to have a consistent positive impact on students' questioning skills.

Overall, learning with the e-worksheet consistently improved students' questioning skills (Figure 2). The implementation of the e-worksheet learning method trained students' questioning skills in both classes. Students' questioning skills in both classes increased, with moderate and high categories. The scientific process performed by students stimulated their curiosity about scientific phenomena, leading to improved questioning skills (Harefa et al., 2020). Siswa termotivasi untuk aktif dan kritis dalam proses pembelajaran. Siswa semakin mampu mengajukan pertanyaan yang lebih baik dan relevan seiring berjalannya waktu.

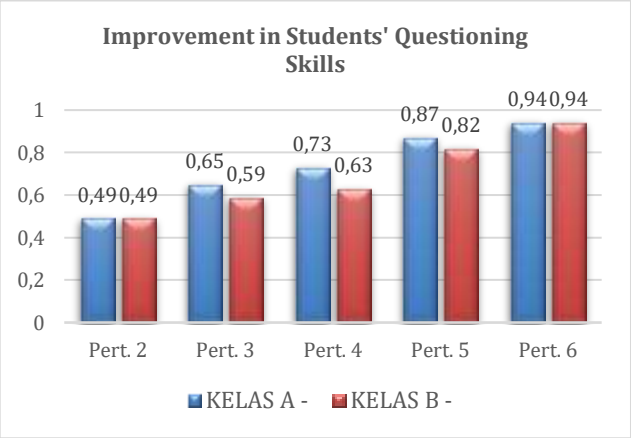

Figure 3: Improvement in Students' Questioning Skills

The improvement in students' learning outcomes in classes VIA and VIB through the use of e-worksheet based on a scientific approach is evident from the comparison of pre-test and post-test results presented in Tables 6 and 7. These results demonstrate the effectiveness of the e-worksheet in enhancing students' understanding and academic performance. Through a series of evaluations, the study identifies changes in students' learning outcomes, reflecting how the e-worksheet not only presents material in an interactive and engaging manner but also stimulates student involvement in the learning process.

With the applied scientific approach, students are able to develop critical thinking skills, as well as the ability to apply the knowledge they have acquired (Muhardini et al., 2021). The analysis of the research findings provides insights into the success and challenges encountered in the implementation of the e-worksheet, and offers recommendations for further improvement and development in technology-based learning practices.

Table 9. Students' Learning Outcomes in Class VIA

Data	**Class VIA**	
	Pre-Test	**Post Test**
Number of Students	31	31
Lowest Score	30	70
Highest Score	90	100
Average Score	57,5	86,8
Standard Deviation	16,95	12,22
N- Gain	**0,75**	
Criteria	**High**	

Table 10. Students' Learning Outcomes in Class VIB

Data	**Class VIB**	
	Pre-Test	**Post Test**
Number of Students	30	30
Lowest Score	30	60
Highest Score	90	100
Average Score	53,45	84,83
Standard Deviation	19,61	12,22
N- Gain	**0,74**	
Criteria	**High**	

Tables 9 and 10 present data on the improvement of student learning outcomes through N-Gain analysis, which indicates the effectiveness of the teaching method used. In class VIA, the N-Gain score reached 0.75, indicating an improvement in student learning outcomes after participating in the lessons. Meanwhile, class VIB showed an N-Gain score of 0.74, also reflecting an improvement, though slightly lower than class VIA. The high criteria indicate that the use of e-worksheet with a scientific approach in learning successfully had a positive impact on conceptual mastery. The learning process has been proven to be effective in improving learning outcomes both quantitatively and in building student motivation and self-confidence. This suggests that the applied teaching process can be maintained and even further developed to enhance teaching strategies that

support improving student learning outcomes, especially for those who may still face difficulties. Overall, this research confirms that the use of e-worksheet with a scientific approach in classes VIA and VIB is effective in improving student learning outcomes, providing a solid foundation to continue and strengthen the method that has been successfully implemented.

D. CONCLUSION AND SUGGESTION

The research results indicate that the product, an e-worksheet with a scientific approach, has been validated with excellent results. The syllabus validation showed a score of 100.00 for completeness, core competencies, indicators, and learning resources (Very Valid), while the learning material and assessment received a score of 83.30 (Very Valid), and the learning activities scored 75.00 (Valid). The RPP (Lesson Plan) validation showed perfect scores of 100.00 (Very Valid) for lesson identity and indicators. For the E-LKPD (electronic student worksheets), content alignment scored 93.80, and language and graphics received a score of 88.90 (all Very Valid). The practicality test also showed excellent results. In class VIA, the preliminary activities increased from a score of 81.25 (Practical) in the second meeting to 100 (Very Practical) in the fourth to sixth meetings. The core activities improved from 82.7 to 98.08, and the closing activities consistently scored 100 (Very Practical). In class VIB, the preliminary activities remained stable at 97.5, except for the second meeting, where the score was 81.25. The core activities varied between 82.69 and 98.08, while the closing activities always scored 100 (Very Practical). The effectiveness test showed a significant improvement in questioning skills and student learning outcomes. In class VIA, questioning skills increased from an average of 56.99 to 98.82 with an N-Gain of 0.94 (high), while in class VIB, the average increased from 59.72 to 86.94 with an N-Gain of 0.94 (high). Learning outcomes also improved, with class VIA achieving an average pre-test score of 57.5 and post-test score of 86.8 (N-Gain 0.75, high), and class VIB increasing from a pre-test score of 53.45 to a post-test score of 84.83 (N-Gain 0.74, high). With validation, practicality, and effectiveness results predominantly rated as Very Good, this research suggests that the scientific process embedded in the scientific approach and packaged in a learning guide can facilitate students in building ideas and curiosity about science.

Therefore, teachers need to design innovative learning resources and implement them in teaching to continuously help students develop thinking skills, which will positively impact their learning outcomes.

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