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# Assessment as Learning (AaL)-oriented IPAS student worksheet to enhance the critical thinking skills of fourth-grade elementary school students

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**Abstract**

The research objective is to develop a science and social science student worksheet (LKPD IPAS) oriented toward Assessment as Learning (AaL) to enhance the critical thinking skills of fourth-grade elementary school students. This study employs a Research and Development (R&D) approach using the ADDIE development model. The research population comprises fourth-grade students from the Ki Hajar Dewantara Cluster in Tanjung Harapan in Central Lampung. The research sample includes fourth-grade students from SDN 1 Tanjung Harapan. Data collection was carried out using valid and reliable test instruments. The results indicate that: (1) the AaL-oriented LKPD IPAS is valid, as demonstrated by the validation results from content experts (0.6240), media experts (0.7639), and language experts (0.6250); (2) the LKPD IPAS is practical for use, as indicated by the practicality percentages from teachers (96%) and students (91.9%); and (3) the LKPD IPAS is effective in improving students' critical thinking skills, as evidenced by an N-Gain score of 0.6351. Therefore, it can be concluded that the AaL-oriented LKPD IPAS is valid, practical, and effective in enhancing the critical thinking abilities of fourth-grade elementary school students.

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## 1. Introduction

In the Fourth Industrial Revolution context, students are expected to master knowledge and essential skills such as metacognition, critical and creative thinking, and effective communication and collaboration (Hafild et al., 2025; Widodo et al., 2020). The Kurikulum Merdeka (Independent Curriculum) is a ground-breaking initiative in Indonesia's education system to nurture a generation of excellence. By promoting intradisciplinary learning with diverse content, this curriculum provides students with opportunities to deepen their conceptual understanding and enhance their competencies (Angga et al., 2022). This reform

aligns with the imperatives of 21st-century education, which underscores the cultivation of creativity, critical thinking, communication skills, and collaborative abilities. These competencies are essential for preparing students to navigate and succeed in an increasingly complex and dynamic global landscape (Papagiannis & Pallaris, 2024; Brandt, 2024). Educational frameworks emphasise integrating these skills to foster deeper learning and adaptability in students (Sánchez Milara & Cortés Orduña, 2024; Mazzola, 2020). Critical thinking, in particular, is defined as the active and skilful process of analysing, formulating, and evaluating information, which is crucial for students' success in their learning endeavours (Hasanah et al., 2021; Qondias et al., 2022).

However, according to global assessments such as the International Educational Achievement (IEA), the Trends in International Mathematics and Science Study (TIMSS), and the Programme for International Student Assessment (PISA), Indonesian students' performance in reading, science, and mathematics lags behind their peers in other countries. As of 2022, Indonesia's scores were 366 in mathematics, 359 in literacy, and 383 in science (OECD, 2023). One of the key features of the Kurikulum Merdeka is the integration of natural and social sciences into a single subject, *Ilmu Pengetahuan Alam dan Sosial* (IPAS), aimed at enhancing the quality of primary education in Indonesia.

Despite its potential, the initial implementation of IPAS has not been fully optimised. This is evident from the observations and interviews conducted by the researcher on July 16, 2024, which focused on the learning processes of fourth-grade teachers within the Ki Hajar Dewantara cluster in Tanjung Harapan Village, Seputih Banyak Subdistrict. The data from four teachers across three schools—SDN 1, SDN 2, and SDN 3 Tanjung Harapan—highlighted significant weaknesses, particularly the lack of student engagement in the assessment process. Teachers failed to involve students in setting learning objectives, establishing success criteria, selecting learning tasks, monitoring outcomes, or providing constructive feedback. Additionally, the learning process was hindered by a shortage of textbooks, and instruction often focused solely on completing textbook content rather than fostering students' critical thinking abilities.

A needs analysis conducted by the researcher revealed that the critical thinking skills of fourth-grade students were generally low. The average scores across various critical thinking indicators were as follows: providing simple explanations (44), developing basic skills (42), drawing conclusions (43), providing further explanation (43), and strategising and planning (42). These findings are consistent with previous studies by Rahmadhani (2024) and Fadillah et al. (2025), which reported similarly low levels of critical thinking skills in IPAS subjects among students in Lampung.

A significant factor contributing to the suboptimal development of critical thinking skills in IPAS learning is the absence of instructional materials, such as student worksheets (LKPD), and the lack of student involvement in the assessment process. This issue has resulted in the absence of valuable feedback for teachers to improve their teaching strategies. In response, the Kurikulum Merdeka integrates three types of assessment: Assessment as Learning (AaL), Assessment for Learning (AfL), and Assessment of Learning (AoL).

LKPDs are structured learning tools designed to systematically present information and questions that help students understand complex concepts. These tools support teachers in delivering content while encouraging students to learn independently and complete written tasks (Marshel & Ratnawulan, 2020; Effendi, 2021; Asmana et al., 2023). The LKPD developed in this study is oriented toward Assessment as Learning (AaL), incorporating strategies that promote metacognitive awareness. This approach allows students to monitor their learning and use reflections to enhance their critical thinking skills. AaL necessitates a shift in teachers' roles


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

from knowledge providers to facilitators who guide students through cognitive processes, enabling them to self-monitor and adjust their learning strategies. Self-regulated learning is a fundamental element of AaL, which is characteristic of student-centred approaches to assessment and learning, including writing tests, self-assessments, and peer assessments (Muchlis et al., 2022; Prihantoro, 2022; Rini & Cahyanto, 2020).

Given this rationale, it is evident that an IPAS-oriented LKPD that aligns with the principles of Assessment as Learning (AaL) and meets the criteria for validity, practicality, and effectiveness in enhancing the critical thinking skills of fourth-grade students is needed.

## 2. Literature Review

Critical thinking is understanding, applying, integrating, and evaluating newly acquired knowledge or information. In this context, it is understood that not all new information received is automatically regarded as accurate or used as a basis for action (Perdana et al., 2020). Critical thinking is an active and skilful process of analysing, formulating, and evaluating information. Developing this ability is essential for students to succeed in learning (Hasanah et al., 2021; Qondias et al., 2022). It is designed to help individuals make reasonable choices about what should be considered valid (Kurniawan et al., 2021). The indicators of critical thinking used in this study are based on the expert opinion of Ennis (2011), which include providing simple explanations, building basic skills, drawing conclusions, providing further explanation, and strategising and planning.

Student Worksheets (*Lembar Kegiatan Peserta Didik* or LKPD) are printed learning media containing theoretical concepts, summarised materials, activity guidelines, and task sheets that serve as guides for students to conduct inquiry and problem-solving through demonstrations or experiments—individually or in groups—thus supporting active involvement in the learning process (Trianto, 2024). Worksheets offer students opportunities to practice and sharpen their critical thinking skills; they are easy to use, beneficial, and visually engaging (Pramudiyanti et al., 2023). Learning Activity Sheets (LKPD) must adhere to key criteria—didactic, constructive, and technical—to ensure their effectiveness as pedagogical tools. These standards enable LKPD to facilitate active learning, align with curriculum objectives, and accommodate diverse student needs (Kurniawati et al., 2021; Sari et al., 2022; Zubaidah et al., 2020). Furthermore, well-designed LKPD promotes higher-order thinking skills and student autonomy, which are critical in 21st-century education (Purnama & Jailani, 2023).

Based on BKSAP Decree No. 033/H/KR/2022, IPAS (Integrated Science and Social Studies) is the study of the universe, including the relationships between living beings and inanimate objects, as well as human life as a social group that constantly interacts with its environment. According to Mazidah & Sartika (2023), IPAS is an integrated form of learning designed to help students develop critical and logical thinking skills. IPAS represents a curriculum innovation that merges science and social studies into a unified learning topic to foster interest in learning, curiosity, active participation, and to enhance students' knowledge and skills (Agustina et al., 2022; Rusilowati, 2022). In this study, the IPAS Learning Objectives (*Capaian Pembelajaran* or CP) focus on students' ability to identify the process of changes in matter and energy transformation in daily life.

Assessment is conducted to evaluate how learning objectives have been achieved. Ideally, assessment involves three approaches: Assessment as Learning (AaL), Assessment of Learning**,** and Assessment for Learning. The Ministry of Education (2010) explains that AaL is a process that supports and develops students' metacognitive skills. In this process, students


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

actively monitor their learning, using self-feedback and feedback from teachers and peers, to determine the next steps and set individual learning goals. Consequently, students learn to manage, monitor, and adjust their learning processes. Self-regulated learning is a key component of this approach, reflecting the core characteristics of learner-centred education and assessment, often implemented through written assignments, self-assessment, and peer assessment (Muchlis et al., 2022; Prihantoro, 2022; Rini & Cahyanto, 2020). Assessment as Learning (AaL) is a formative assessment approach that fosters student self-reflection, autonomous learning, and metacognitive development (Daniar et al., 2023). By engaging students in self-monitoring and goal-setting, AaL shifts the focus from teacher-led evaluation to learner agency, ultimately enhancing long-term knowledge retention (Earl & Katz, 2021; Yan et al., 2022). Research further demonstrates that AaL strategies—such as peer feedback and reflective journals—improve critical thinking and reduce dependency on summative assessments (Panadero et al., 2023; Wanner & Palmer, 2023).

Generally, four well-established learning theories are commonly applied in educational processes: behaviourism, cognitive theory, humanistic theory, and constructivist theory (Herliani et al., 2021). Behaviourism emphasises changes in student behaviour due to stimuli and responses (Budiarto & Sunardi, 2024). In this theory, learning and assessment are centred on learning outcomes (Wahab & Rosnawati, 2021). Cognitive theory, proposed by Ausubel, Bruner, and Gagné, highlights learning as a result of continuous interaction between individuals and their environment through assimilation and accommodation (Rahmah, 2022). The humanistic theory, pioneered by Abraham Maslow, emphasises the importance of individual potential. Thus, humanistic learning encourages students to be active learners and to develop their potential. As advanced by Piaget, Vygotsky, and Bruner (Prasetyo & Suciptaningsih, 2022), constructivist theory posits that teachers should not merely deliver knowledge but engage students in constructing their understanding (Trianto, 2024).

## 3. Method

This developmental research employs a Research and Development (R&D) approach using the ADDIE model. Research and Development (R&D) is a type of research used to create a product. The research activities are conducted to gather information regarding user needs (needs assessment), while the development activities focus on designing and producing the product. This study aims to develop an IPAS student worksheet (LKPD) using the Assessment as Learning (AaL) approach to improve the critical thinking skills of fourth-grade elementary school students.

This study's population comprises 75 fourth-grade students from the Ki Hajar Dewantara school cluster in Tanjung Harapan. The sample was selected through cluster random sampling, including students from classes IVA and IVB at SDN 1 Tanjung Harapan. This study follows the ADDIE development model, which includes five phases: Analysis, Design, Development, Implementation, and Evaluation. Figure 1 illustrates the implementation of the ADDIE model.


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

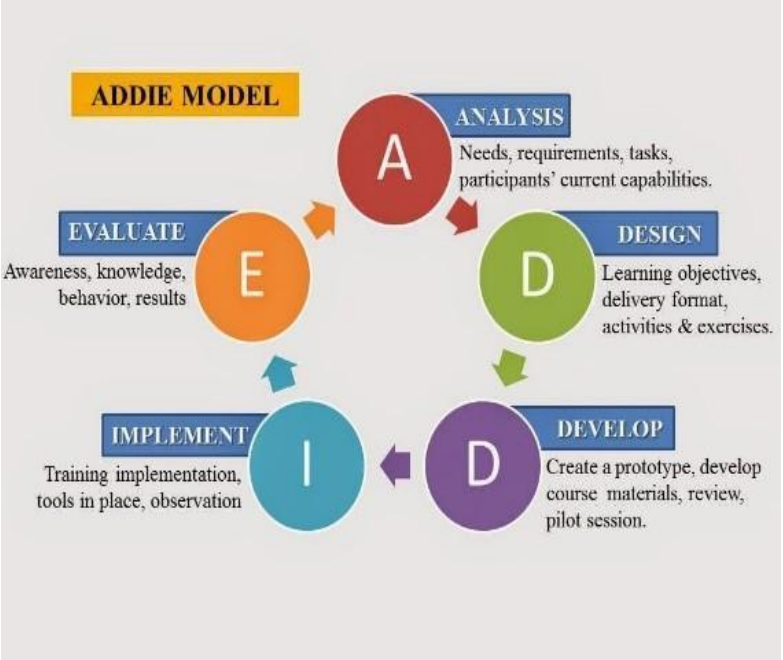



**Figure 1**. R&D Steps Using the ADDIE Approach (Branch, 2009)

The ADDIE research method is applied to describe a structured approach to instructional development. As the foundation for media development, the preliminary research phase includes curriculum, needs, and concept analysis. Curriculum analysis is conducted to identify the Learning Outcomes (*Capaian Pembelajaran* or CP) for the *Ilmu Pengetahuan Alam dan Sosial* (IPAS) subject. Needs analysis aims to identify the issues in IPAS learning for Grade IV, Phase B, through questionnaires distributed to teachers and students and a pre-test to assess students' initial critical thinking abilities. Concept analysis is carried out to understand the process of developing the student worksheet (LKPD).

The development stage includes the creation of the LKPD, the development of research instruments, and the validation by experts in content, media, and language. The implementation stage consists of a limited trial, a large-group trial, and a final revision. The evaluation stage involves product assessment. Evaluation is carried out at each stage of the ADDIE model. Considering the scope of the study focuses solely on the validity, practicality, and effectiveness testing phases, this method is deemed most appropriate for the conditions and objectives of this learning product development (Waruwu, 2024).

Data were collected using test and non-test instruments (Ali Ibrahim et al., 2024). The test instrument included pre-test and post-test essay questions to assess students' critical thinking skills before and after the learning process. The non-test instruments included interviews, observations, and questionnaires. The research findings are expected to produce a valid, practical, and effective student worksheet (LKPD) that enhances students' critical thinking abilities. Through the Assessment as Learning (AaL) approach, this study is also expected to contribute to the assessment process in IPAS Phase B learning.

## 4. Results

This study aims to improve the critical thinking skills of fourth-grade elementary school students using an IPAS student worksheet (LKPD) based on the Assessment as Learning (AaL)

approach. The product was tested on fourth-grade students from the Ki Hajar Dewantara school cluster in Tanjung Harapan through the ADDIE development model, which consists of the following stages:

***a. Analysis***

The analysis stage includes a curriculum and needs analysis of teachers and students. This analysis examined the current curriculum, namely the Kurikulum Merdeka. Key elements analysed in the curriculum include the Learning Outcomes (*Capaian Pembelajaran* or CP) related to phase changes in matter. The CP requires students to identify the process of phase changes and energy transformation in daily life.

Needs analysis observations were conducted on four teachers across the Ki Hajar Dewantara school cluster: SDN 1 Tanjung Harapan, SDN 2 Tanjung Harapan, and SDN 3 Tanjung Harapan. The results showed that the teachers had not fully understood the competencies expected of students in the 21st century. Consequently, teachers had not yet made optimal efforts to improve students' critical thinking skills. Assessment as Learning (AaL) had not been implemented in the learning process, and LKPDs were not used as instructional materials. Following the preliminary research, all fourth-grade teachers in the Ki Hajar Dewantara cluster agreed on developing appropriate teaching materials to help students actively engage in learning.

Based on interviews and observations, it was also revealed that teachers had not yet incorporated LKPDs into their lessons and that students were not significantly involved in the assessment process—whether through self-assessment, peer assessment, or participation in setting learning objectives.

An initial test was administered to assess the critical thinking skills of 75 fourth-grade students across the Ki Hajar Dewantara school cluster. This initial test was based on the critical thinking indicators proposed by Ennis (2011), which include: providing simple explanations, building basic skills, drawing conclusions, providing further explanations, and organising strategies and tactics. The results of the critical thinking skills test are presented in Table 1.

**Table 1.** Analysis results of the critical thinking skills test

| Indicators | Averages |
|---|---|
| Providing Simple Explanations | 44 |
| Building Basic Skills | 42 |
| Drawing Conclusion | 43 |
| Providing Further Explanations | 43 |
| Organising Strategies and Tactics | 42 |

The results of the needs analysis regarding the initial critical thinking skills of fourth-grade students show that the average scores for each critical thinking indicator are as follows: providing simple explanations – 44, developing basic skills – 42, concluding – 43, providing further explanations – 43, and organising strategies and tactics – 42. Based on this need's analysis, the initial critical thinking ability of the fourth-grade students is considered low.

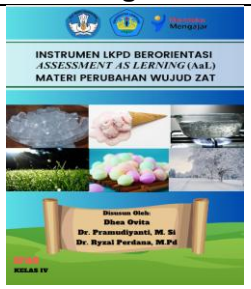
***b. Design***

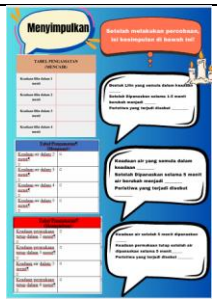
Several activities were carried out at the design stage to design the IPAS LKPD oriented toward Assessment as Learning (AaL). One of the key steps in this stage was the creation of a storyboard, which served as a central element in the LKPD development process. The AaL-


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

oriented IPAS LKPD was designed using the critical thinking indicators proposed by Ennis (2011). These include providing simple explanations, building basic skills, drawing conclusions, providing further explanations, and organising strategies and tactics. Table 2 presents the specific components that structure the LKPD.

**Table 2.** Storyboard of the IPAS Student Worksheet (LKPD) Oriented Toward Assessment as Learning (AaL)

| No. | LKPD Design | Description |
|---|---|---|
| 1. |  <br>  | The first cover contains the title:<br>Assessment as Learning (AaL) Instrument on the Topic of Phase Changes of Matter for Grade IV,<br>along with the names of the authors:<br>1. Dhea Ovita<br>2. Dr.Pramudiyanti, M. Si<br>3. Dr. Ryzal Perdana, M.Pd<br><br>The second cover is the cover page of the developed Student Worksheet (LKPD) |
| 2. |  | Student Identity Page |
| 3. |  | Learning Outcomes (CP) and Learning Objectives (TP) Page<br>The Learning Outcomes (*Capaian Pembelajaran*/CP) refer to the expected results after students complete the learning process using the LKPD.<br>The Learning Objectives (*Tujuan Pembelajaran*/TP) are specific statements describing the intended outcomes students should achieve in each activity within the e-LKPD. |

| | | |
|---|---|---|
| 4. |  <br>  | First Meeting Page – Critical Thinking Indicator: Providing Simple Explanations<br>This page stimulates critical thinking by presenting fundamental questions to assess students' ability to provide simple explanations. The questions are structured to guide students in articulating basic reasoning and understanding of the topic. |
| 5. |  | Critical Thinking Indicator Page – Building Basic Skills<br>This stage encourages collaboration, concept visualisation, and alignment of planning with learning objectives. It guides students in conducting investigations related to phase changes of matter. |
| 6. |  | Critical Thinking Indicator Page – Drawing Conclusions<br>This stage monitors students' progress and engagement during the activity, particularly their ability to manage time and take responsibility. It also facilitates teachers' effective tracking of students' investigations. |
| 7. |  | Critical Thinking Indicator Page – Providing Further Explanations<br>This stage monitors students' ability to provide deeper or extended explanations based on the investigations they have conducted. |


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

| | | |
|---|---|---|
| 8. |  | Critical Thinking Indicator Page – Organising Strategies and Tactics<br>This stage assesses the students' ability to objectively measure the success of their investigation and conduct evaluations to improve their results. |

***c. Development***

The LKPD's development process involved three validation stages to assess its content, media, and language quality. Validation data were obtained from subject matter experts, media experts, and language experts. Table 3 summarises the validation results from the experts.

**Table 3.** Summary of expert validation results

| No. | Validators | Average Aiken's V Score | Criteria |
|---|---|---|---|
| 1. | Subject Expert | 0,6240 | Valid |
| 2. | Media Expert | 0,7639 | Valid |
| 3. | Language Expert | 0,6250 | Valid |

The content expert's validation results show an average holistic Aiken's V score of 0.6240, which falls into the valid category. Meanwhile, the media expert's validation yields an average holistic Aiken's V score of 0.7639, also considered valid. The language expert's assessment produces an average holistic Aiken's V score of 0.6250, which is likewise considered valid.

**d. Implementation**

The implementation stage aims to evaluate the product's practicality and readability, and to gain an overall understanding of the IPAS LKPD oriented toward Assessment as Learning (AaL) that has been developed. This stage involved both limited-scale trials and field testing. The limited trial included six randomly selected fourth-grade students, each from SDN 2 Tanjung Harapan and SDN 3 Tanjung Harapan. The limited trial results are presented in Table 4.

**Table 4.** Results of limited trial

| No. | Aspects | Averages | Category |
|---|---|---|---|
| 1 | Subject | 91,7 | Convenient |
| 2 | Presentation | 91 | Convenient |
| 3 | Language | 93 | Convenient |
| **Averages** | | **91,9** | **Convenient** |

Based on the limited trial results, the content aspect receives an average score of 91.7, classified as "convenient;" the presentation aspect receives an average score of 91, also categorised as "convenient;" and the language aspect reaches an average score of 93, which likewise falls under the "convenient" category. Overall, the average score across all aspects is 91.9, indicating that the LKPD is considered "very practical."

Following the limited trial, a field trial was conducted at SDN 1 Tanjung Harapan. This trial involved an experimental class of 26 students and a control class of 27 students. Two fourth-grade teachers and the 26 students from the experimental class assessed the practicality of the LKPD during the field trial. The results of the practicality assessment by the teachers are presented in Table 5.

**Table 5.** Teachers' practicality assessment results from the field trial

| No. | Aspects | Averages | Category |
|---|---|---|---|
| 1 | Subject | 96 | Convenient |
| 2 | Presentation | 98 | Convenient |
| 3 | Language | 94 | Convenient |
| **Averages** | | **96** | **Convenient** |

Based on the teachers' practicality assessment, the content aspect receives an average score of 96, which is classified as "convenient." The presentation aspect achieves an average score of 98, also falling under the "convenient" category, while the language aspect receives an average score of 94, likewise categorised as "convenient." Therefore, the overall average score across the three aspects in the field trial is 96, which is considered "very practical."

Subsequently, the practicality assessment results from the students in the field trial are presented in Table 6.

**Table 6**. Students' practicality assessment results from the field trial

| No. | Aspects | Averages | Category |
|---|---|---|---|
| 1 | Subject | 91,1 | Convenient |
| 2 | Presentation | 90,8 | Convenient |
| 3 | Language | 93,1' | Convenient |
| **Averages** | | **Convenient** | |

The results of the practicality assessment by students indicate that the content aspect receives an average score of 91.1, classified as "convenient." The presentation aspect scores an average of 90.8, also in the "convenient" category, while the language aspect achieves an average of 93.1, likewise categorised as "convenient." Overall, the average score across the three aspects in the field trial is 91.9, which is considered "convenient."

### e. Evaluation

The evaluation stage was conducted on an experimental class of 26 students and a control class of 27 students to assess the effectiveness of the IPAS LKPD oriented toward Assessment as Learning (AaL). Table 7 presents the students' average pre-test and post-test scores.

**Table 7.** Average pre-test and post-test students' scores

| Classes | *N-Gain* | Criteria |
|---|---|---|
| **Experiment** | 0,6351 | Moderate |
| **Control** | 0,4752 | Moderate |

Table 7 shows that the N-Gain score obtained is 0.6351, which falls within the “moderate” category. The researcher's analysis of students’ critical thinking skills is presented in Table 8.

**Table 8.** Identification of critical thinking skills of fourth-grade students at SDN 1 Tanjung Harapan

| No. | Indicators | Control Group Average | Experimental Group Average |
|---|---|---|---|
| 1. | Providing Simple Explanations | 69 | 80 |
| 2. | Building Basic Skills | 69 | 78 |
| 3. | Drawing Conclusion | 68 | 80 |
| 4. | Providing Further Explanations | 73 | 82 |
| 5. | Organising Strategies and Tactics | 79 | 75 |

Based on Table 8, which presents the identification of critical thinking skills of fourth-grade students at SD Negeri 1 Tanjung Harapan, information is provided for each indicator of critical thinking in both the control and experimental classes. For the indicator providing a simple explanation, the control class has an average score of 69, while the experimental class achieves an average score of 80. The control class obtains an average score of 69 for the indicator building basic skills, while the experimental class reveals 78. On the drawing conclusions indicator, the control class has an average score of 68, compared to 80 in the experimental class. In the indicator providing further explanation, the control class scores an average of 73, whereas the experimental class reaches 82. However, on the developing strategies and tactics indicator, the control class obtains an average score of 79, while the experimental class receives a slightly lower average of 75.

## 5. Discussion

This study employed the Research and Development (R&D) method utilising the ADDIE model, consisting of five phases: Analysis, Design, Development, Implementation, and Evaluation. This approach was used to develop a Science and Social Studies (IPAS) student worksheet (LKPD) oriented towards Assessment as Learning (AaL). The development results show that the IPAS LKPD, designed with an AaL orientation, is "valid" for enhancing students' critical thinking skills. This conclusion is supported by the results of product validation conducted by multiple experts in their respective fields, aiming to assess the appropriateness of the developed product.

The validation process involved three validators: material, media, and language experts. The validation results were derived from the average assessment scores of each validator, based on their specific evaluation aspects. The material experts' validation yielded an average Aiken index of 0.7639, categorising it as "Valid." The media experts' validation produced an average Aiken index of 0.6240, also classified as "Valid." Likewise, the language experts' validation resulted in an average Aiken index of 0.6250, which was similarly categorised as "Valid." This finding aligns with Ariani et al. (2025), who stated that a learning product is considered valid if the Aiken index exceeds 0.60. Safitri et al. (2022) also found that an Aiken’s V score range of 0.62–0.66 falls within the acceptable validity range. Amalia and Nurul (2023) emphasised that validation scores within this range reflect consistent expert assessments. Furthermore, Yuliana and Rahmawati (2020) concluded that an Aiken index above 0.60 meets the feasibility threshold for further development in educational media. Thus, the validation


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

results of this study are empirically supported by prior research and confirm that the developed student worksheets are suitable for classroom implementation.

The product's practicality was assessed through the evaluation of various components by educators and students using a questionnaire. This instrument collected data from educators and students, and the average score was calculated for each component. The practicality was evaluated during limited and field trials. The limited trial involved 12 students, six from SDN 2 Tanjung Harapan and six from SDN 3 Tanjung Harapan. The limited trial practicality test yielded an average score of 91.9, categorised as "convenient." Based on this result, the conclusion from the limited trial is that the product is convenient for the subsequent stage, the field test (large-scale trial). This finding is supported by Suhardi et al. (2021), Hayati and Sinta (2023), and Khairunisa et al. (2024), who confirmed the practical application of student worksheets in educational settings. Therefore, the research findings are empirically supported and demonstrate that the developed product is convenient for the field trial phase.

In the field trial, two teachers and 26 students at SD Negeri 1 Tanjung Harapan further evaluated the product's practicality. The two teachers included one from class IV-A and one from class IV-B. The practicality assessment by both teachers resulted in an average score of 96, categorised as "convenient." Similarly, the practicality assessment of 26 students in class IV-A yielded an average score of 91.9, also classified as "convenient." Based on these results, it can be concluded that the AaL-oriented IPAS LKPD is both practical and effective in improving the critical thinking skills of fourth-grade students.

The product's effectiveness was tested with 26 fourth-grade students from SD Negeri 1 Tanjung Harapan using the IPAS LKPD on Changes in the State of Matter. The results showed a Normalised Gain (N-Gain) score of 63.51% (moderate category) and an effect size of 5.643 (very high category), indicating that the AaL-based LKPD is effective in enhancing students' critical thinking skills. The obtained N-Gain score of 63.51% falls within the moderate effectiveness category, indicating that while the intervention demonstrated significant impact, there remains potential for further optimisation of learning outcomes. According to established benchmarks, N-Gain scores exceeding 70% represent highly effective interventions (Rosdiana et al., 2020). This finding aligns with contemporary research demonstrating that moderate N-Gain scores (50-75%) often reflect meaningful but improvable learning gains (Ardiansyah & Suryadi, 2020). The results suggest that incorporating enhanced interactive elements, as proposed in recent studies (Finkenstaedt et al., 2023; Zhang et al., 2022), could potentially elevate the intervention's effectiveness into the high-gain category. External factors, such as student motivation and teaching quality, may also influence the N-Gain results, requiring further research to examine these variables and improve teaching strategies to enhance N-Gain scores (Purnama, 2021).

Theoretically, the effectiveness of this study is grounded in constructivist learning theory, which emphasises that learners actively build their understanding through meaningful experiences. AaL-based worksheets engage students in the assessment and reflection process, fostering their knowledge construction (Piaget, as cited in Woolfolk, 2017). In this context, students are not passive recipients of assessments but active participants who self-regulate their learning. This finding aligns with Sari and Suryani (2023), who observed that AaL approaches significantly improve higher-order thinking skills through student engagement in self-evaluation. Dewi and Yustitia (2022) further argued that AaL, rooted in constructivism, effectively develops students' metacognitive awareness, a key critical thinking component. Nasution et al. (2021) also affirmed that reflective-based LKPD helps students build their understanding progressively and logically. Therefore, this study's findings demonstrate statistical effectiveness and theoretical alignment with active and constructivist learning


[ e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514 ]

principles, establishing the AaL-oriented IPAS LKPD as an effective and relevant instructional tool.

## 6. Conclusion and Implications

Based on the research results and analysis conducted, it can be concluded that the IPAS student worksheet (LKPD), oriented toward Assessment as Learning (AaL), meets the criteria of being valid, practical, and effective in enhancing the critical thinking skills of fourth-grade elementary school students. The product's validity is supported by expert assessments regarding content, media, and language, indicating that the material is aligned with the learning objectives and appropriate for the students' developmental level.

The practicality of the LKPD was demonstrated through positive responses from teachers and students during the limited and field trials. The LKPD was considered easy to use, well-structured, and supportive of active learning. Meanwhile, its effectiveness was evidenced by improvements in students' critical thinking abilities, as reflected in the N-Gain scores and the significant difference between the pre-test and post-test results in the experimental group compared to the control group.

Therefore, the development of this AaL-oriented LKPD contributes not only to improving critical thinking but also supports the implementation of 21st-century learning strategies aligned with the objectives of the Kurikulum Merdeka. The product can be a meaningful resource for teachers to foster student-centred learning and formative assessment practices in the classroom.

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