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Development of HOTS based Science test instruments for grade IV SDN Moarah 01 Klampis

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Key Words:

IPAS, HOTS, test instrument, ADDIE, elementary school.

Abstract: This research is intended to develop a Higher Order Thinking Skills (HOTS) based IPAS assessment instrument for fourth-grade students at SDN Moarah 01 Klampis. The development is motivated by students' low higher-order thinking skills and the lack of a'sessment instruments that effectively measure analytical (C4), evaluative (C5), and creative (C6) thinking abilities. This study employs a Research and Development (R&D) approach using the ADDIE model, which includes five phases: analysis, design, development, implementation, and evaluation. The subjects of this study were 11 fourth-grade students and 4 fifth-grade students, with validation carried out by subject matter experts, language experts, and evaluation experts.The results show that the developed instrument is categorized as highly valid in terms of material (96%), language (93.3%), and evaluation (94.7%). In the trial phase, the cognitive assessment results indicate that most students achieved the Minimum Learning Mastery Criteria (KKTP) in both small group and large group trials. In addition, observation results show that students were actively engaged during the test implementation and demonstrated higher-order thinking processes in solving IPAS related problems. Based on these findings, it can be concluded that the developed HOTS based IPAS test instrument is suitable for use as an assessment tool 'n elementary schools. This instrument not only evaluates students' learning outcomes but also facilitates the enhancement of higher order thinking skills in alignment with the demands of 21st-century education.

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INTRODUCTION

Education serves as a fundamental pillar in the formation and advancement of human resource quality. In Indonesia, the implementation of education is grounded in the values of Pancasila and the 1945 Constitution, as stated as outlined in Law Number 20 of 2003 concerning the National Education System. Education is aimed at developing students' potential to become individuals who are faithful, morally upright, knowledgeable, creative, independent, and capable of critical and responsible thinking. Achieving these objectives requires learning processes that emphasize the advancement of higher order thinking skills (HOTS). The Merdeka Curriculum, as a recent educational reform in Indonesia, emphasizes the mastery of 21st century skills, particularly critical, analytical, and creative thinking. A key implementation at the elementary education level involves the integration of Natural Sciences (IPA) and Social Sciences (IPS) into a single subject, namely Natural and Social Sciences (IPAS). This integration aligns with students' developmental characteristics in fostering inquiry skills (Suhelayanti, 2023) and responds to the evolving demands of contemporary life (Zahra, 2024). Consequently, IPAS learning is designed to promote scientific reasoning and critical thinking.

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From a theoretical perspective, IPAS learning inherently involves higher-order thinking processes, including analysis, evaluation, and creation, which are categorized under levels C4, C5, and C6 in the revised Bloom's taxonomy. These skills play a vital role in facilitating students' development of deep conceptual understanding through scientific inquiry, (Dermawan et al., 2021). Furthermore, learning activities that engage students in analytical and evaluative processes represent the practical implementation of HOTS (Fai et al., 2025). Therefore, mastery of IPAS concepts is closely linked to students' higher-order thinking abilities (Suci et al., 2021), and low HOTS proficiency reflects inadequate conceptual understanding (Indriyana et al., 2024). However, empirical evidence indicates that students' higher-order thinking skills remain low. A preliminary study conducted in grade IV at UPTD SDN Moarah 01 Klampis revealed that the average pretest score in IPAS was 42, significantly below the minimum mastery criterion of 70. Most students demonstrated difficulties in answering questions that required analytical, evaluative, and creative thinking. This finding highlights a discrepancy between curriculum expectations and students' actual cognitive performance.

This issue is linked to the limited adoption of HOTS-oriented assessment practices. Predominantly, current evaluation methods emphasize lower-order thinking skills (LOTS), resulting in restricted opportunities for students to develop advanced cognitive abilities. As a consequence, students' analytical skills and conceptual understanding remain underdeveloped. These findings corroborate the study by Rizki et al. (2024), which revealed that students' critical and analytical thinking skills require further enhancement, and that many educational institutions have not developed HOTS-based assessment instruments that satisfy adequate validity criteria. Their study, employing a Research and Development approach with a 4D model, demonstrated that the developed instruments were valid, reliable, and exhibited strong construct validity. This underscores the importance of developing high-quality HOTS-based assessment instruments to enhance educational assessment practices.

In this regard, formative assessment serves a critical function in enhancing the learning process by delivering continuous feedback and tracking students' progress over time, (WD et al., 2022). Therefore, the development of HOTS-based formative assessment is imperative to enable both the evaluation and advancement of students' higher-order thinking skills. In this regard, the study aims to development of HOTS based Science test instruments for grade IV SDN Moarah 01 Klampis. The study is expected to contribute to the improvement of assessment quality and to support the more effective achievement of learning objectives.

METHODS

This study implemented a Research and Development (R&D) methodology to develop a HOTS-based IPAS test instrument, which is designed to produce and validate educational products, (Sugiyono, 2023). The study adopted the ADDIE model as its development framework, encompassing five sequential stages: analysis, design, development, implementation, and evaluation, (Rahayu, 2025; Anafi et al., 2021). The research was carried out at SDN Moarah 01 Klampis, with 11 fourth grade students serving as the study participants. To ensure the instrument's quality, validation was conducted by experts in content, assessment, and language. The instrument used was a HOTS based test designed to measure higher-order thinking skills at the levels of analysis (C4), evaluation (C5), and creation (C6).

Data were obtained using multiple techniques, namely observation, interviews, needs analysis questionnaires, and a final test. Observation and interviews were used to obtain initial data, the questionnaire to identify development needs, and the final test to measure students' higher-order thinking skills (Sugiyono, 2023). DataThis study employed both qualitative and quantitative data analysis techniques. Qualitative data, obtained from expert feedback, served as the basis for instrument revision. Meanwhile, quantitative data were used to evaluate the instrument's validity and effectiveness. Validity was determined through expert validation using a Likert scale, and effectiveness was assessed based on students' performance on the final test.

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RESULTS

The development of the HOTS based IPAS test instrument in this study employed the ADDIE model, encompassing five sequential stages: analysis, design, development, implementation, and evaluation. Each stage was executed systematically to ensure the production of a valid instrument. At the analysis stage, the researcher examined learning needs, including competency requirements, student characteristics, and classroom-related challenges. The findings demonstrated that students' higher-order thinking skills were still inadequate, particularly in the domains of analysis, evaluation, and creation. Additionally, the previously utilized assessment instruments had not effectively measured HOTS, thereby underscoring the necessity for developing more appropriate instruments.

In the design stage, the researcher formulated a test blueprint grounded in the Grade IV IPAS learning objectives. The test items were systematically developed to assess higher-order thinking skills at the C4 (analysis), C5 (evaluation), and C6 (creation) levels. Additionally, validation instruments were constructed to evaluate item quality in terms of content, linguistic accuracy, and assessment aspects. A pie chart was also included to represent the distribution of test items across HOTS cognitive levels, as shown below:

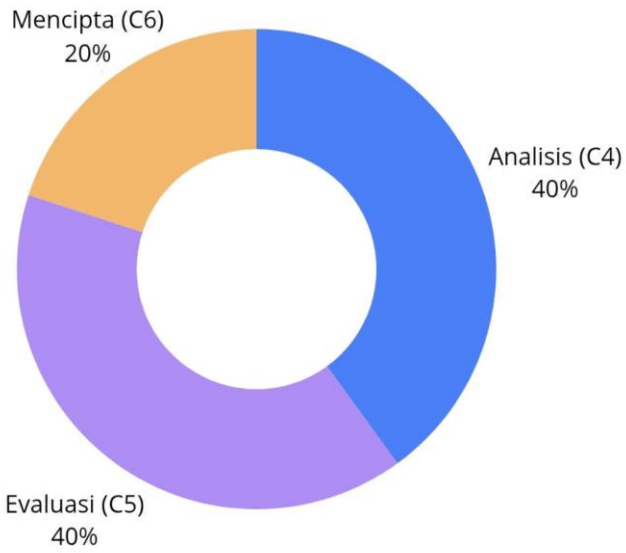


Figure 1. Pie Chart Showing the Distribution of HOTS Test Items Across C4, C5, and C6 Levels

In the development stage, the designed instruments were actualized into a product comprising a set of HOTS-based test items. Subsequently, the instruments underwent expert validation involving specialists in content, language, and evaluation. The table below illustrates the validation results obtained from the subject matter expert, evaluation expert, and language expert:

Table 1. Results of Expert Validation

No.	Validation Experts	Score	Criteria
1	Subject Matter Expert	96%	Highly valid
2	Evaluation Instrument Expert	93,3%	Highly valid
3	Language Expert	94,7%	Highly valid

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In the implementation stage, the validated instruments were piloted in two phases, consisting of a small-group trial and a large-group trial. The small-group trial comprised 8 students, whereas the large-group trial involved 15 students.

Table 2. Student Response Questionnaire

No	Group Trial	Student Response Score
1	**Small group trial**	**94,1%**
2	**Large group trial**	**94,4%**

In the evaluation stage, all validation and trial data were systematically analyzed to determine the validity level of the instruments. The results demonstrate that the developed HOTS-based IPAS test instruments fulfilled the criteria of high validity.

DISCUSSION

This study aims to develop a Higher Order Thinking Skills (HOTS)-based IPAS (Natural and Social Sciences) test instrument for fourth-grade students at SDN Moarah 01 Klampis. The development of this instrument was intended to produce an assessment tool capable of measuring students' higher-order thinking skills, particularly in the domains of analysis (C4), evaluation (C5), and creation (C6). Based on the results of expert validation, the developed instrument was classified as highly valid across three primary aspects: content, language, and assessment.

The validation results from the material expert yielded a score of 96%, indicating a highly valid category. This finding demonstrates that the test items are aligned with the IPAS learning outcomes for Phase B, the characteristics of fourth-grade elementary students, and accurate scientific concepts, especially on the topic of insect life cycles and metamorphosis. Moreover, the items were designed to incorporate higher-order thinking skills, requiring students to analyze phenomena, evaluate information, and generate creative ideas or solutions. The questions were also developed using a contextual approach, in accordance with the principles of contextual learning and HOTS-based instruction.

In terms of language, the validation results showed a score of 93.3%, which is also categorized as highly valid. The language used in the instrument was considered clear, communicative, and appropriate to the cognitive level of elementary school students. The sentence structures were generally well-organized and easy to understand, although certain parts required simplification to improve conciseness and effectiveness. Additionally, the use of scientific terminology was appropriate to the learning content and did not lead to conceptual misunderstandings. Regarding spelling and grammar, the instrument adhered to proper Indonesian language conventions, thereby supporting its overall readability.

Meanwhile, the evaluation expert validation results showed a score of 94.7%, also categorized as highly valid. This indicates that the instrument is aligned with the IPAS learning objectives, particularly on the topic of life cycles of living things. The developed items cover HOTS cognitive levels, including analysis, evaluation, and creation. Each item is also equipped with contextual stimuli relevant to students' daily life, encouraging higher-order thinking skills. The answer choices were designed by considering difficulty level and distractor quality, although some improvements are still needed to further enhance the assessment quality.

Overall, the findings from expert validation confirm that the developed HOTS-based IPAS test instrument is categorized as highly valid and suitable for implementation as an assessment tool for fourth-grade students at SDN Moarah 01 Klampis. This indicates that the instrument fulfills established feasibility standards in terms of content, language, and construct validity, thereby supporting the accurate assessment of students' higher order thinking skills.

To evaluate the quality of the developed instrument, trials were conducted through cognitive assessments in both small-group and large-group settings. In the small-group trial involving 8 students, the results indicated that 7 students met the Minimum Learning Mastery Criteria (KKTP) with scores ranging from 80 to 100, while 1 student did not

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achieve mastery, obtaining a score of 40. These findings reflect variations in students' abilities to respond to HOTS-based items, particularly in the domains of analysis (C4), evaluation (C5), and creation (C6). The student who did not meet the mastery criterion demonstrated difficulty in linking fundamental IPAS concepts with problem based HOTS questions.

Furthermore, in the large-group trial involving 15 students, 14 students achieved mastery with scores between 80 and 100, whereas 1 student did not meet the criterion, scoring 40. Overall, these results suggest that most students were capable of answering items designed to measure higher-order thinking skills. Students showed adequate competence in understanding concepts, analyzing problems, and determining appropriate answers based on the given stimuli. In addition to the cognitive assessment results, observational data indicated that students were actively engaged during the testing process. They not only responded to the items individually but also demonstrated cognitive processes such as interpreting question contexts, analyzing information, and drawing conclusions. This suggests that the developed instrument not only serves as a tool for measuring learning outcomes but also promotes the engagement of students in higher-order thinking processes. Therefore, it can be concluded that the developed HOTS-based IPAS test instrument for fourth-grade students at SDN Moarah 01 Klampis demonstrates strong quality in terms of validity and trial outcomes. The instrument is capable of representing students' higher-order thinking abilities and is appropriate for use as an assessment tool in accordance with the demands of 21st-century learning.

CONCLUSION

Based on the results of this research and development, it can be concluded that the HOTS-based IPAS (Natural and Social Sciences) test instrument developed for fourth-grade students at SDN Moarah 01 Klampis has met the feasibility criteria in terms of validity. This validity was established through expert judgment involving material, language, and evaluation experts. The validation findings indicate that the instrument is categorized as highly valid across all assessed aspects. From the content perspective, the material expert evaluation confirms that the instrument is well aligned with the Phase B IPAS learning outcomes, the characteristics of fourth-grade elementary students, and the integration of higher-order thinking skills at the levels of C4 (analysis), C5 (evaluation), and C6 (creation). In terms of language, the instrument is considered clear, communicative, and appropriate for the cognitive development level of elementary school students. Meanwhile, from the evaluation aspect, the instrument has been systematically designed in accordance with learning objectives, supported by contextual stimuli, and is capable of measuring students' higher-order thinking skills effectively. The results of both small-group and large-group trials indicate that the majority of students achieved the Minimum Learning Mastery Criteria (KKTP). This suggests that students were generally able to respond to items measuring analysis, evaluation, and creation skills, although some difficulties were still observed in certain indicators. In addition, observational data reveal that students were actively engaged during the completion of the instrument and demonstrated higher-order thinking processes in understanding and solving the given tasks. Therefore, it can be concluded that the developed HOTS-based IPAS test instrument for fourth-grade students at SDN Moarah 01 Klampis is valid and appropriate for use as a learning assessment tool. The instrument fulfills validity standards and is capable of accurately measuring students' higher-order thinking skills. Furthermore, it is expected to serve as an alternative assessment tool that supports more meaningful IPAS learning and promotes the development of 21st-century skills.

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