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Research Article

Fostering Scientific Reasoning and Understanding: Developing Jumping Task-Based Learning Materials for the Solar System Topic in Primary Education

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ABSTRACT

Development of Jumping Task-Based Lkpd to Improve Student Achievement of Learning Outcomes. This study aims to develop Jumping Task-based worksheets that can be used to improve student achievement. This research is a research and development research and development (R&D) using the ADDIE research model. Collecting data using the method of observation, interviews, and questionnaires. Observations were made during the analysis of the school environment. Interviews are needed to determine the needs of teachers, students, and problems in the learning process. Questionnaires were used to assess the validity of the Student Worksheet from the aspect of material, media, use of Student Worksheet, and implementation of learning, and were used in trials to students to measure the feasibility of Student Worksheet based on Jumping Task. The subjects of this study were 46 students of class VI. This research produces Student Worksheet based on Jumping Task in the solar system science subjects. The results showed the average pretest 69,71 and the average posttest 79,49. The results of the calculation of the achievement of affective aspects obtained the final value of class VIA, namely 87.92 with very high criteria, class VIB getting a score of 85,46 with very high criteria. While the results of the calculation of the achievement of psychomotor aspects at the end of class IVA, namely 86,25 with very high criteria, class VIB got a score of 82,08 with very high criteria. So it can be concluded that the developed Student Worksheet can improve student achievement.

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INTRODUCTION

The ultimate goal of national education, as enshrined in the Constitution of Indonesia, is to educate the nation's life, a mandate realized through a conscious, planned effort to develop students' potential (Government of Indonesia, Law Number 20 of 2003). In this dynamic era, fulfilling this mandate requires educators to continuously innovate learning systems and tools to meet evolving educational demands (Rizqika, et.al 2019). One critical component of this endeavor is the development of effective teaching materials that actively engage students and foster higher-order thinking skills, moving beyond rote memorization toward meaningful conceptual understanding.

Student Worksheets, known as Student Worksheet, are recognized as learning resources in curricula such as Indonesia's 2013 curriculum. They serve as a bridge between teachers and students, guiding learners in discovering concepts through structured activities and problems (Dewi, and Susilowibowo, 2016). However, conventional Student Worksheet often falls short, as they can be monotonous, text-heavy, and fail to stimulate curiosity (Khairunisa, et.al 2020). In the contemporary educational landscape, there is a pressing need for Student Worksheet that are not only informative but also interactive and visually appealing, incorporating multimedia elements to create a more engaging and practical learning experience (Rohman, et.al 2023).

The challenge extends beyond mere presentation; the cognitive demand of the tasks within the Student Worksheet is paramount. Traditional worksheets often focus on procedural and low-cognitive tasks, which do not adequately prepare students for the complex problem-solving required in the 21st century (McCormick, et.al 2021). To address this, pedagogical strategies that explicitly target critical and scientific reasoning are essential. This is where the concept of a Jumping Task becomes highly relevant. A Jumping Task is a challenging question or problem that exceeds standard curricular requirements, designed to provoke deep thinking and the application of knowledge in novel situations (Hobri, and Susanto. 2016; Admin, and Asari, 2017).

The theoretical underpinning of Jumping Tasks aligns with Vygotskian principles of learning, which emphasize the importance of challenging activities within a student's zone of proximal development to maximize cognitive growth (Vygotsky, 1978). By presenting problems that cannot be solved through the direct application of a learned procedure, Jumping Tasks stimulate students' metacognitive abilities, forcing them to analyze, evaluate, and create solutions by connecting and restructuring their existing knowledge (Polya 1957, Sugiarto, et.al 2018. This process is crucial for developing scientific reasoning the ability to think like a scientist, formulate hypotheses, and construct evidence-based explanations (Duschl, et.al. 2007).

The domain of astronomy, particularly the solar system, presents a fertile ground for applying Jumping Tasks. This topic involves abstract concepts and spatial relationships that are difficult to grasp through traditional instruction alone (Plummer 2014). It naturally invites inquiry, wonder, and complex questions about the universe, making it an ideal context for tasks that require reasoning, model-based thinking, and problem-solving beyond simple fact recall. Therefore, developing learning materials that embed challenging tasks within this content area has significant potential to enhance both conceptual understanding and reasoning skills.

While the Jumping Task strategy has been explored in mathematics education (Hobri, and Susanto 2016; Admin, and Asari, (2017), Sugiarto, et.al 2018), its application in primary science education, especially in the context of developing interactive Student Worksheet, remains relatively underexplored. Prior research has shown that well-designed, inquiry-based worksheets can improve science process skills and environmental awareness (Rohman, et.al 2023; Pratiwi, et.al 2024), 15]. Furthermore, problem-based learning (PBL) worksheets have been proven to enhance critical thinking in elementary science (Pramudiyanti et.al 2023). This study seeks to extend this line of inquiry by integrating the specific principles of Jumping Tasks into the design of Student Worksheet

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for science, aiming to create a learning tool that is not just a source of information but a catalyst for advanced cognitive engagement.

Based on this rationale, this study aims to develop and evaluate Jumping Task-Based Student Worksheet for the solar system topic in primary education. The research focuses on assessing the validity, practicality, and effectiveness of these innovative materials in improving student achievement across cognitive, affective, and psychomotor domains. It is hypothesized that by confronting students with appropriately challenging tasks within a structured worksheet, their scientific reasoning, understanding of the solar system, and overall learning achievement will be significantly enhanced.

METHOD

This study is a Research and Development (R&D) study using the ADDIE research model. The ADDIE model stands for Analyze, Design, Development, Implementation, and Evaluation (Nurjanah et al., 2019; Sutarti & Irawan, 2017). The validity test of this study was conducted by one subject matter expert, one media expert, and one teacher. After the Student Worksheet was assessed by the experts, it was then tested by students on a limited scale. The subjects of this study were 46 sixth-grade science students with different characteristics. Data collection in this study used observation, interviews, and questionnaires. Observations were conducted during the analysis of the school environment. Interviews were needed to determine the needs of teachers and students and the problems encountered in the learning process so that the content analysis used in the development of the Student Worksheet could be identified. Questionnaires were used to assess the validity of the Student Worksheet in terms of material, media, use of the Student Worksheet, and implementation of learning. They were also used in conducting trials with students to measure the feasibility of the Jumping Task-based Student Worksheet.

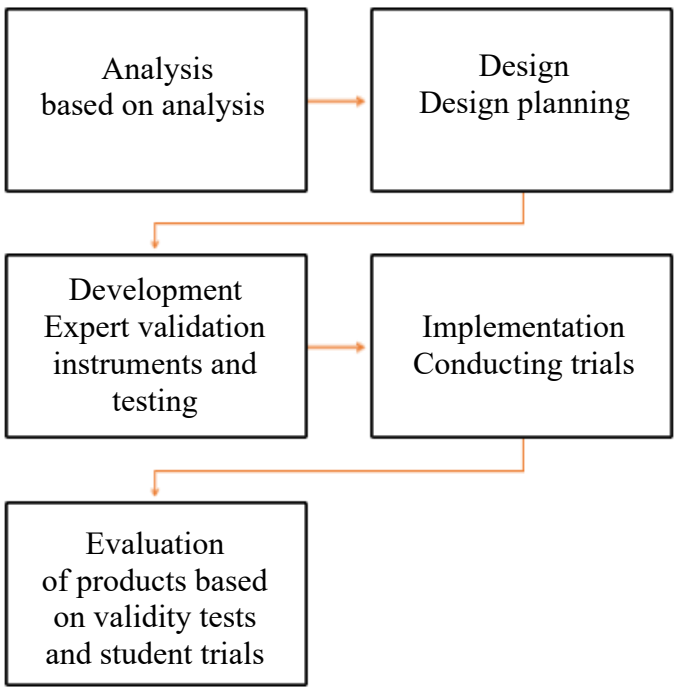

Figure 1. Implementation steps using the ADDIE model

The data obtained was qualitative descriptive data obtained through expert reviews in the form of critiques. Meanwhile, quantitative data was obtained from validation instruments, practicality, and student learning outcomes to determine the feasibility of the developed product. In making decisions,

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this study used a 5-point Likert scale, which was then used to determine the assessment percentage. The criteria for instrument validation are as follows.

Table 1. Classification of validity tests

Range Scale	Classification
$V > 0{,}84$	Very Valid
$V > 0{,}68 – 0{,}84$	Valid
$V > 0{,}52 – 0{,}68$	Fairly Valid
$V > 0{,}36 – 0{,}52$	Less Valid
$V \leq 0{,}36$	Invalid

To measure practicality, the following criteria are used.

Table 2. Practicality Criteria

Average Score	Average Score/Percentage	Classification
$\overline{X} > 4{,}2$	$\overline{X} > 84$	Very Practical
$\overline{X} > 3{,}4 – 4{,}2$	$\overline{X} > 68 – 84$	Practical
$\overline{X} > 2{,}6 – 3{,}4$	$\overline{X} > 52 – 68$	Quite Practical
$\overline{X} > 1{,}8 – 2{,}6$	$\overline{X} > 36 – 52$	Less Practical
$\overline{X} \leq 1{,}8$	$\overline{X} \leq 36$	Not Practical

Then, to see the improvement in learning, the researchers used the following n-Gain criteria.

Table 3. Gain improvement criteria

N-Gain	Normalized Score
g-high	$g \geq 0{,}7$
g-medium	$0{,}7 > g \geq 0{,}3$
g-low	$g < 0{,}3$

RESULT AND DISCUSSION

Jumping Task-based Student Worksheet was developed using the ADDIE model with five stages, namely the analysis stage, the planning stage, the design stage, the development stage, the implementation stage, and the evaluation stage. The following are the steps for developing Jumping Task-based Student Worksheet:

Analysis

At this stage, researchers analyzed the needs of educators and students and conducted material analysis. The method used was a questionnaire distribution. Based on the analysis results, it was found that students felt bored in learning, due to the monotonous media used. Based on the results of interviews with educators, it was found that educators only use the learning media that have been provided. Educators have also not been able to develop learning media that can build student motivation in learning. In addition, the worksheets are usually not made by the teachers themselves, so students are not enthusiastic about doing them. This is because they are considered monotonous, contain too many questions, and are not interesting.

Design

The design stage in this study was designed to prepare the learning activities to be developed. There are five design stages carried out in the development based on the analysis of the needs of elementary school students in designing Student Worksheet, which include 1) flowchart creation, 2) storyboard, 3) material, 4) question compilation, and 5) Student Worksheet design creation, which

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consists of background creation, a collection of images and videos to be included in the Student Worksheet.

Figure 2. Student Worksheet Before Revision

Figure 3. Student Worksheet After Revision

Development.

The development stage in this research is to find and collect various resources to enrich the material. At this stage, the activities carried out are:

1) Creating Student Worksheet through the design stage. This activity includes developing the design of the Student Worksheet content, listing the steps for filling out the Student Worksheet, and listing the Basic Competencies, placing images based on the material, and presenting questions based on Jumping Tasks.
2) Creating product validity instruments to be assessed by subject matter experts, media experts, and students.
3) Testing the validity of the products created by validators, namely subject matter experts, media experts, and educators.

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Validation was carried out to assess the feasibility of the Student Worksheet. The components observed included content feasibility, language, and graphics. Before validating the Student Worksheet, the Student Worksheet validation sheet was first validated. The Student Worksheet validation sheet obtained a score of 0.82, which is considered valid, so it can be concluded that the sheet can be used to validate the Student Worksheet. The Student Worksheet Validation Sheet Test results obtained a score of 0.82, which is valid, so it can be concluded that the Student Worksheet Validation Sheet Test results can be used.

The Student Worksheet validation test was conducted by three validators who are competent in their fields. The validation test was conducted to assess three components, namely content feasibility, language, and graphics. The results of the Student Worksheet validation test can be seen in the following table:

Table 4. Student Worksheet Validation Results

Observed Components	*V*	Description
Content Suitability	0,83	Valid
Language	0,80	Valid
Graphics	0,69	Valid
Holistic Index	0,77	Valid

The three validators gave good assessments to each component evaluated with valid descriptions for each component. This shows that the Student Worksheet developed can be used to measure the learning outcomes of students. The results of the cognitive, affective, and psychomotor test validation can be seen in the following table.

Table 5. Cognitive Sheet Validation Test Results

Observed Components	*V*	Describtion
Cognitive Assessment	0,82	Valid

Table 6. Affective Sheet Validation Test Results

Assessment Indicators	*V*	Describtion
Clarity	0,83	Valid
Assessment Criteria	0,79	Valid
Linguistic Appropriateness	0,88	Valid

Table 7. Results of Psychomotor Sheet Validation Test

Graded Aspects	*V*	Describtion
Aspects Of Instructions	0,81	Valid
Content	0,79	Valid
Inguistic Appropriateness	0,83	Valid

The validation test results on the cognitive sheet obtained a score of 0.82 with a valid rating. The results of the affective sheet test with straightforward assessment indicators obtained a score of 0.83 with a valid rating, the clarity of assessment criteria indicator obtained a score of 0.79 with a valid rating, and the indicator of conformity with language rules obtained a score of 0.88 with a valid rating. Then, in the psychomotor sheet validation test results, the assessed aspect, namely the instructions aspect, obtained a score of 0.81 with a valid description, the content aspect obtained a score of 0.79 with a valid description, and the language rules compliance aspect obtained a score of 0.83 with a valid description. From the results of the cognitive, affective, and psychomotor validation sheets, it can be concluded that the validation sheets are suitable for use.

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Implementation

The implementation stage in this study was carried out after the Student Worksheet was tested for validity by experts. This stage was carried out to determine the responses of students and teachers to the developed Student Worksheet. The practicality test was carried out on students in classes VIA and VIB and two class teachers as a basis for drawing conclusions about the practicality of using the Student Worksheet. The results of the student practicality test can be seen in the following graph.

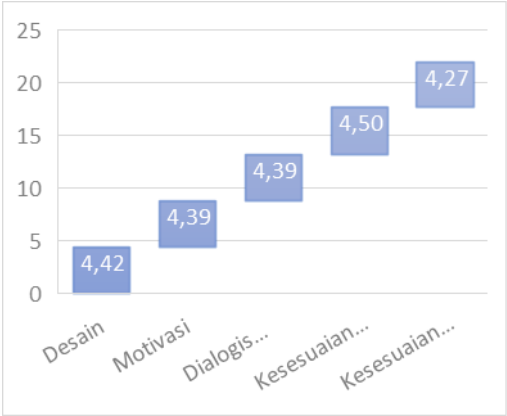

Figure 4. Results of the Practicality Test for VIA Students

Practical description, interactive dialogue 4.39 with practical criteria, student suitability 4.50 with practical criteria, language suitability 4.27 with practical description. From the results of the data analysis above, it can be concluded that the practicality is 4.39 on average. The following are the practicality results of VIB students.

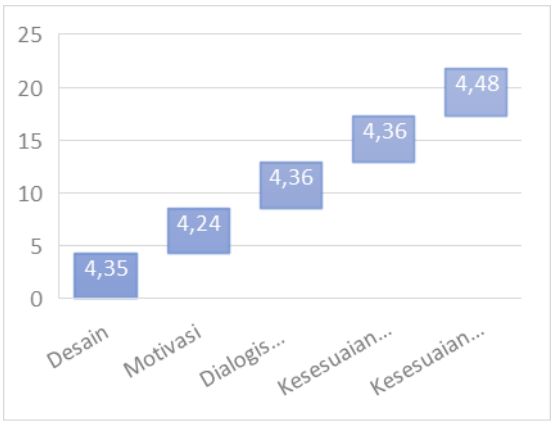

Figure 5. Results of the Practicality Test for Grade VIB Students

Very practical, motivation 4.24 with practical description, interactive dialogue 4.36 with very practical criteria, student suitability 4.36 with very practical criteria, language suitability 4.48 with very practical description. From the results of the data analysis above, it can be concluded that it is very practical to use with an average of 4.36. Then, the results of the Student Worksheet practicality test on teachers were as follows.

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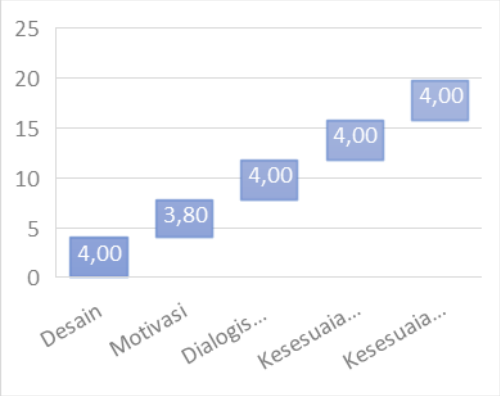

Figure 6. Results of the Teacher Practicality Test

From each component of the practicality test, the following scores were obtained: design 4.00 with the description "very practical," motivation 3.80 with the description "practical," interactive dialogue 4.00 with the criteria "very practical," student suitability 4.00 with the criteria "very practical," and language suitability 4.00 with the description "very practical." From the results of the data analysis above, it can be concluded that it is practical to use with an average of 3.39. The practicality test results show that the use of Student Worksheet can develop student enthusiasm in the learning process and make students think at a higher level.

1. Student Achievement Test Results

The learning outcomes as a reference for student achievement in learning can be seen as follows. In the cognitive aspect, the pretest and posttest averages are as follows.

Table 8. Cognitive Achievement Results

Class	Student Numbers	Pretest	Posttest
VIA	24	70,88	79,83
VB	22	68,55	79,14

The pretest average score was 69.71, while the posttest average score was 79.49. These results were then analyzed using the gain formula as follows. The calculation result was 0.323, which is considered moderate. Therefore, it can be concluded that there was learning achievement among students using Jumping Tasks-based worksheets in science lessons on the solar system.

To support the learning achievement of students, the researcher presents the results of the affective and psychomotor assessment analysis as follows.

Table 9. Affective Achievement Results

Class	Student Numbers	Final Score	Criteria
VIA	24	87,92	Sangat tinggi
VIB	22	85,46	Sangat tinggi

As a result of the calculation of the achievement of the affective aspect, the final score for class VIA was 87.92, with a very high criterion, while class VIB obtained a score of 85.46, also with a very high criterion. From this analysis, it can be concluded that there is an improvement in the learning achievement of the students using Jumping Taks-based Student Worksheet in the science learning on the Solar System material. Below are the results of the assessment on the psychomotor aspect.

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Table 10. Results of Psychomotor Achievement

Class	Student Numbers	Final Score	Criteria
VIA	24	86,25	Very High
VIB	22	89,55	Very High

From the calculation results of the achievement of the Psychomotor aspect, the final score for class VIA is 86.25 with a very high criterion, class VIB scored 89.55 with a very high criterion. From this analysis, it can be concluded that there is an increase in student learning achievement using Jumping Taks-based Student Worksheet in science learning on the Solar System material.

Evaluation

At this stage, evaluation is conducted based on suggestions and input from the previous stage. Validation tests are carried out using questionnaires completed by subject matter experts and media experts, as well as feasibility tests by students. The results of validation by subject matter experts, covering quality aspects, indicate a validity result in the good category, while the accuracy of the material and questions received a validity result with a very good predicate. As for the material and questions, up to now, the validity result is categorized as very good, and the ecosystem material aspect obtained a validity result with a good predicate. The results of the media expert validation include aspects of media appearance, obtaining a validity result with a very good predicate, then assessed from the attractiveness of the Student Worksheet media with a very good validity result, and the prospect of ease of use of Student Worksheet received a validity result with a good predicate.

CONCLUSION

The development of the Student Worksheet based on Jumping Tasks was carried out in several stages, namely analysis, design, development, implementation, and evaluation. The procedures carried out at the design stage include doing or creating what is needed, formative evaluation, and design revision. The result obtained is that the Student Worksheet is suitable for use. Then the Student Worksheet was tested with a science teacher. In the implementation stage, 46 students or one class, namely class VI, were involved. Based on the evaluation conducted, it was found that the Student Worksheet based on Jumping Tasks is valid according to the validator expert team, received positive feedback from the science teacher, and was positively assessed by students during the Student Worksheet product trial, so the Student Worksheet did not require revision for the implementation stage. The quality of the Student Worksheet based on Jumping Tasks can be seen from three aspects: valid, practical, and effective. Validity is obtained from the validator team, stating that the Student Worksheet is suitable for use. The level of practicality is seen from the validators and the results of the observation sheets of student activities. The effectiveness of the Student Worksheet is seen from the positive responses of students and the results of student learning tests. In this study, it can be seen that the learning outcomes of students in the solar system and universe material have improved. Based on the research results and discussions, it can be concluded that the collaborative learning devices with proven content validity can be seen from the average pretest score (69.71) and the average posttest score (79.49). The final score for the affective aspect achievement was obtained in class VIA, which is 87.92 with a very high criterion, while class VIB received a score of 85.46 with a very high criterion. Meanwhile, the calculation results for the psychomotor aspect achievement at the end of class IVA is 86.25 with a very high criterion, class VIB received a score of 82.08 with a very high criterion. Thus, it can be concluded that the developed Student Worksheet can improve students' learning achievements.

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