

Implementation Of The Project-Based Learning (PjBL) Model Based on Differentiated Instruction to Improve Integrated Science Concept Understanding of Grade VII Students at Risk of Learning Difficulties

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Abstract

This study aims to improve students' learning process and learning outcomes through the implementation of a differentiated instruction-based Project-Based Learning (PjBL) model for Grade VII students at risk of learning difficulties in the topic of water pollution. This research is necessary because the teaching methods currently employed by teachers have not been effective in improving students' learning process and learning outcomes in accordance with curriculum requirements. As a result, students continue to experience difficulties in participating in the learning process. This study employed a Classroom Action Research (CAR) approach using the Kemmis and McTaggart model, which consists of four stages: planning, action, observation, and reflection. The study was conducted in two cycles. The research subjects were two Grade VII students identified as being at risk of learning difficulties. Data collection techniques included observation and achievement tests (written tests). The data were analyzed using quantitative descriptive statistical techniques and qualitative descriptive analysis. Data were presented using tables and diagrams. Hypothesis testing was conducted by comparing pre-action results, Cycle I results, and Cycle II results. The results of the study show that the implementation of PjBL model based on differentiated instruction for students at risk of learning difficulties in Grade VII significantly improved both the learning process and learning outcomes. In the pre-action phase, the research subjects, Ju and Jd, obtained scores of 40 and 30, respectively. In Cycle I, their scores increased to 60 and 50. After Cycle II, both students achieved a score of 80. In addition, there was an increase in student engagement during the learning process. These findings indicate that the



implementation of the PjBL model based on differentiated instruction is an effective and applicable strategy for improving conceptual understanding and learning outcomes of students at risk of learning difficulties. Therefore, teachers are recommended to implement the PjBL model based on differentiated instruction to better address the individual needs of learners.

Keywords: *Project-Based Learning (PjBL), Differentiated Instruction, Students At Risk Of Learning Difficulties, Learning Outcomes*

INTRODUCTION

Education is a fundamental matter that must be fulfilled to educate the nation's life, and the progress and development of a nation are closely related to the education of its citizens. Referring to the 1945 Constitution article 31 paragraph (1) which states "that every citizen has the right to obtain education". Inclusive education is an effort to ensure all students, including those with disabilities, have equitable access, which ensures that all students can maximize their potential (Saleh et al., 2025). Integrated science in junior high schools is a combination of various scientific fields such as: physics, chemistry, biology, earth and space, as well as technology and society (Mas'ud et al., 2021). Science education or integrated natural sciences today demands the development of comprehensive scientific literacy, where students not only memorize facts but can connect scientific concepts with real-life phenomena (Kementerian Pendidikan, Kebudayaan, Riset, 2022).

In the inclusive learning process, the main problem is overcoming learning challenges that arise due to the mismatch between conventional learning approaches and students' special needs. A learning obstacle is a situation where students experience a condition that can result in a failure to achieve learning objectives (Herlina et al., 2023). The problem of learning obstacles can affect students' ability to understand concepts, participate actively in class, and achieve the best academic results (Risanatul & Junaidi, 2022). Children with learning obstacles have constraints in understanding and using media and learning methods properly and with focus (Gabriel & Börnert-Ringleb, 2023). Students experiencing learning obstacles often have difficulty processing abstract information, which if not handled properly will cause students to lack motivation and self-confidence (Mumpuniarti, 2017).

Objective conditions in the classroom often show a highly varied level of student diversity, both in terms of learning styles, social backgrounds, and cognitive abilities. According to Tomlinson (1999), effective education must pay attention to differences in student interests,



learning readiness, and learning characteristics through differentiated instruction. Differentiated instruction is a pedagogical approach carried out through intentional and planned adjustments to content, process, products, and the learning environment to accommodate the diverse learning needs of students (Smale-Jacobse et al., 2019). This method provides opportunities for teachers to change strategies, activities, and learning methods to meet differences in student learning styles and needs (Pozas et al., 2021). The application of differentiated instruction allows educators to meet the diversity of student needs by adjusting instruction which can increase student engagement, self-confidence, and learning outcomes, including students facing learning difficulties (Pozas et al., 2021).

Overcoming this problem requires a learning intervention that can transform abstract material into real experiences through the Project Based Learning (PjBL) model. Project-based activities driven by the PjBL learning model encourage students to investigate, analyze, and find solutions to problems around them (Mayasari et al., 2022). PjBL is an innovative model that has many important strategies for success in the modern era, and provides students with many opportunities to show their creativity (Azzahra et al., 2023). Research published in the journal *Frontiers* shows that PjBL makes students understand subject matter in a real-world context and develops engagement and critical thinking processes in learning (D'Elia et al., 2025). Project-based learning in experimental subjects makes students develop a better understanding of the basics and practices of experiments, increases interest and desire to learn, and encourages the development of creative thinking skills and active learning (Zhang & Ma, 2023). The results show that PjBL can effectively improve academic achievement and reduce the student achievement gap and strikingly, PjBL has a more positive effect (Lin et al., 2025).

The main problem identified is the low understanding of integrated science concepts. This is evidenced by data showing that the KKTP (Criteria for Attainment of Learning Objectives) score for Integrated Science is 71, while the students' average test score is only 43. In grade VII of SMP Negeri 2 Malinau Selatan Hulu, initial observations and academic data showed that there was a fundamental problem with the achievement of science learning outcomes. Two out of eight students showed significant difficulties in processing data, understanding complex instructions, and relating abstract science concepts. Therefore, this study was designed to improve the learning process and conceptual understanding of Integrated Science of grade VII students at risk of learning difficulties through the implementation of a differentiated instruction-based PjBL model.



RESEARCH METHODOLOGY

This research is a Classroom Action Research (CAR) aimed at improving the integrated science conceptual understanding of students at risk of learning difficulties. The study followed the Kemmis and McTaggart model, consisting of four main steps: planning, action, observation, and reflection, conducted collaboratively and participatively over two cycles. The research was conducted at SMP Negeri 2 Malinau Selatan Hulu in grade VII. The subjects were two 12-year-old male students, identified with the initials Jd and Ju, who showed prominent characteristics of learning difficulties, such as difficulty understanding instructions, limited attention span, and difficulty remembering abstract conceptual information.

The school environment has specific limitations, such as a lack of electricity access, but utilizes the surrounding natural environment, specifically a nearby stream, as a contextual learning source. The action implemented was the Project-Based Learning (PjBL) model based on differentiated instruction focusing on the topic of water pollution. The learning process followed the PjBL syntax: determining fundamental questions, designing project plans, creating schedules, monitoring project implementation, testing results, and evaluating learning experiences. The students were tasked with creating a simple water purifier, with differentiated learning support provided through content (visual media and concrete objects), process (step-by-step scaffolding and heterogeneous grouping), and product (flexible presentation formats).

Data collection techniques used in this study were observation and written tests. Observations were conducted directly in the classroom to systematically record the activities of the teacher and students, project engagement, and student responses during the learning process using observation checklist instruments. The written tests consisted of a pretest given before the intervention to determine initial abilities and a posttest given after the teaching process to measure the students' conceptual understanding of integrated science. To ensure validity, the instruments underwent a validation process through expert assessment before being utilized.

The collected data were analyzed using quantitative and qualitative descriptive analysis techniques. Quantitative data from student learning outcomes were processed by calculating scores, learning improvement percentages, and comparing the pretest and posttest results against the established Criteria for Attainment of Learning Objectives (KKTP) of 71. Qualitative data from the observation of student and teacher activities were analyzed using percentage techniques, which were then interpreted into qualitative categories ranging from "highly active" to "inactive". The success indicator of this classroom action research is achieved if all students obtain a score above the established KKTP of 71.



RESEARCH RESULTS

Pre-action Results

Before the action was taken, science learning was still taking place using conventional methods. The teacher explained the material more, while students listened, taken notes, and answered questions given by the teacher. Under these conditions, students at risk of learning difficulties still experienced difficulties understanding the concept of water pollution because the material was mostly delivered verbally.

The initial conditions showed that students' conceptual understanding was still low. The pretest of the two students at risk of learning difficulties showed poor results, namely 40 and 30, or still far from the Criteria for Attainment of Learning Objectives (KKTP) of 71. These scores indicate that students have not fully understood the water pollution material, especially regarding concepts, characteristics of polluted water, causes of water pollution, and simple ways to reduce water pollution through the filtration process.

Table 1. Pretest Results of Conceptual Understanding in Pre-action

No	Subject	Score	KKTP	Remarks
1	Ju	40	71	Incomplete
2	Jd	30	71	Incomplete

Cycle I Results

In Cycle I, the teacher designed learning using the PjBL model based on differentiated instruction. The first meeting focused on introducing the problem of water pollution, observing cloudy water, introducing tools and materials, and project planning. The second meeting focused on project implementation, testing filtration results, discussion, and evaluation. Students were divided into small groups to arrange filter materials into a bottle and tried filtering cloudy water.

The implementation of Cycle I had not run optimally. Some students, especially those at risk of learning difficulties, still had difficulty following the work steps. They often asked the teacher or group friends repeatedly because the instructions in the Student Worksheet (LKPD) were not easy enough to understand. The main constraint in Cycle I was that the LKPD still lacked pictorial instructions. The work instructions were mostly in written form, so students who had difficulty reading or understanding long instructions required repeated explanations.

Observation results showed that the activity of students Ju and Jd reached 50%. Based on the assessment category in the instrument, a percentage below 61% is included in the less active



category.

Table 2. Observation Results of Student Activity in Cycle I

No	Subject Name	Activity Percentage	Category	Minimum Activity Percentage	Remarks
1	Ju	50%	Less Active	76%	Students began to engage, but still required a lot of direction
2	Jd	50%	Less Active	76%	Students began to engage, but still required a lot of direction

Additionally, the teacher's activity during Cycle I obtained a percentage of 70%, which falls into the "sufficient" category based on the observation instrument.

Table 3. Observation Results of Teacher Activity in Cycle I

No	Subject Name	Activity Percentage	Category	Minimum Activity Percentage	Remarks
1	Teacher	70%	Sufficient	76%	The teacher implemented PjBL, but visual instructions were not optimal

After the Cycle I action was carried out, students were given a test to determine the increase in conceptual understanding. The test results showed an increase in student scores, namely Ju from 40 to 60 and Jd from 30 to 50.

Table 4. Results of Conceptual Understanding in Cycle I

No	Subject Name	Pre-action Score	Cycle I Score	Increase	KKTP	Increase in Percentage
1	Ju	40	60	20	71	50%
2	Jd	30	50	20	71	67%



Cycle II Results

Cycle II was designed based on the reflection results of Cycle I. The main improvement was made to the learning media, specifically the LKPD. The LKPD used in Cycle II was made more attractive, colorful, and picture-based. This change was made as a form of differentiated instruction, namely adjusting the way material is presented to the needs of students at risk of learning difficulties.

During the core activity, students began preparing tools and materials according to the pictures in the LKPD. Students then arranged the filter layers in an easier-to-understand sequence because it had been displayed in a colorful diagram. Students appeared more active and confident. Students at risk of learning difficulties who previously often waited for directions began to be able to follow the activities by looking at the pictures on the LKPD.

Observation results showed an increase in student and teacher activity. Student activity increased from each student who previously obtained a score of 50% in Cycle I to 85% for Ju and 80% for Jd in Cycle II. This percentage is included in the active category.

Table 5. Comparison of Student Activity in Cycle I and II

No	Subject Name	Cycle I	Cycle II	Minimum Activity Percentage	Remarks
1	Ju	50%	85%	76%	Students were actively involved
2	Jd	50%	80%	76%	Students were actively involved

Meanwhile, teacher activity also increased from 70% in Cycle I to 90% in Cycle II, reaching the "good/very good" category.

Table 6. Comparison of Teacher Activity in Cycle I and II

No	Subject Name	Cycle I	Cycle II	Minimum Activity Percentage	Remarks
1	Teacher	70%	90%	76%	The teacher implemented learning maximally

The implementation of the test in Cycle II showed an increase in conceptual understanding



for both students. The scores of Ju and Jd each reached 80, so it can be concluded that the learning in Cycle II successfully achieved the predetermined success indicators.

Table 7. Recapitulation of Conceptual Understanding Results

No	Subject Name	Pre-action Score	Cycle I Score	Cycle II Score	Increase	KKTP	Increase in Percentage
1	Ju	40	60	80	40	71	100%
2	Jd	30	50	80	50	71	125%

DISCUSSIONS

The success of applying the differentiated instruction-based PjBL model in this study can be analyzed through its alignment with the characteristics of students at risk of learning difficulties. The success did not simply occur due to a change in the learning model, but because the model used was able to answer students' learning needs, namely the need for concrete, visual, step-by-step, collaborative learning that involves direct activity.

Based on inclusive education theory, inclusive learning requires teachers to provide educational services that are accessible to all students regardless of their abilities or learning needs. Permendiknas Number 70 of 2009 affirms that inclusive education aims to provide the widest possible opportunity for every student to obtain educational services according to their needs, abilities, and potential. Permendikbudristek Number 48 of 2023 also emphasizes the importance of reasonable accommodation through adjustments to the curriculum, learning processes, environment, and learning media. In this study, this principle was evident through adjusting learning for students at risk of learning difficulties using real projects, visual LKPDs, direct practice, and teacher guidance.

The success of this action is also related to the psychological profile of students at risk of learning difficulties. Students at risk of learning difficulties have weak short-term memory, tend to think concretely, have a limited attention span, and easily lose self-confidence when experiencing failure. Therefore, project-based learning is appropriate because students not only hear the presentation but directly see, feel, arrange, try, and observe the results. This aligns with Oladele (2024) who explained that kinesthetic learning through direct manipulation, physical movement, and real experience can help students understand and remember information better.

The success of the action is also related to differentiated instruction theory. Tomlinson



(2001) explained that learning differentiation is based on differences in student learning readiness, interests, and learning profiles. In this study, differentiation was carried out through simplifying instructions, using colored pictures, providing clear work stages, using concrete objects, and mentoring during the project. These adjustments made it easier for students at risk of learning difficulties to follow the learning process.

From the perspective of the nature of science, the success of the action can be explained through Trianto's (2010) opinion that science is essentially a product, process, and attitude. Students do not only study water pollution material as knowledge, but also conduct simple scientific processes through observing cloudy water, arranging filter materials, filtering experiments, and drawing conclusions based on observations.

From the side of conceptual understanding, Vaiopoulou (2023) explained that conceptual understanding is not just remembering, but the ability to grasp meaning, explain back, connect concepts, and apply them in new situations. Through the simple water purifier project, students not only know the definition of water pollution, but also understand the characteristics of polluted water, the causes of pollution, the impacts of pollution, and a simple way to reduce its impact.

The success of the action is also supported by PjBL theory, where learning through project activities encourages students to investigate, analyze, and find solutions to problems in their environment (Mayasari et al., 2022). The problem of cloudy water is used as a contextual problem close to students' lives. Students are then directed to make a simple water purifier as a form of problem-solving.

CONCLUSION

Based on the classroom action research conducted, the implementation of the Project-Based Learning (PjBL) model based on differentiated instruction successfully improved both the learning process and the conceptual understanding of integrated science for grade VII students at risk of learning difficulties. This was reflected in the significant increase in student activity during the lessons, where participation rose from 50% in Cycle I to 85% for Ju and 80% for Jd in Cycle II, accompanied by an increase in teacher activity from 70% to 90%. The implementation of the cycles demonstrated that providing a structured learning environment supported by visual media and step-by-step guidance successfully enhanced the students' engagement and capability to follow collaborative project activities.

Furthermore, the students' mastery of integrated science concepts regarding water pollution experienced substantial improvement, with test scores increasing from pre-action



averages of 40 for Ju and 30 for Jd, up to 60 and 50 respectively in Cycle I, and ultimately reaching 80 for both students in Cycle II. This progression confirms that utilizing a contextual project—specifically a simple water purifier—combined with differentiated student worksheets (LKPD) effectively bridges the gap between abstract scientific concepts and concrete practical experiences, allowing students at risk of learning difficulties to successfully meet the established criteria for attainment of learning objectives.

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