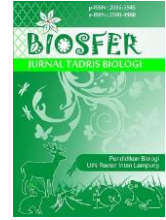




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# Improving Student Learning Outcomes through Project-Based Learning Models in Natural Science

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### ABSTRACT

This research aims to improve the learning outcomes of fifth-grade students through a project-based learning model in natural and social science subjects. This research was classroom action research consisting of several stages: planning, implementation, observation, and reflection. The subject of this research was the fifth-grade students of State Elementary School. The instruments used were written tests and observations. All data were analyzed in a descriptive, quantitative, and qualitative manner. In the first cycle, the average score was 76.7, but students still needed management in collaboration to complete projects. In the second cycle, an average score of 87 was obtained, and students were able to build collaboration in completing the project. This activity is assisted by learning resources in the form of project worksheets, discussion sheets, posters, demonstration sheets, and free-choice enrichment sheet media for students. Based on the results of cycles I and II, it can be concluded that the improvement of student learning outcomes is influenced by a project-based learning model in which students can think critically, solve problems, pour out new ideas, be creative, actively interact, and communicate between groups.

#### *Peningkatan Hasil Belajar Peserta Didik melalui Model Pembeajaran Project Based Learning pada Mata Pelajaran Ilmu Pengetahuan Alam*

**ABSTRAK:** Tujuan penelitian ini untuk meningkatkan hasil belajar peserta didik kelas lima melalui model pembelajaran proyek pada mata Pelajaran Ilmu pengetahuan alam dan social. Penelitian ini merupakan penelitian tindakan kelas yang terdiri dari beberapa tahapan, perencanaan, pelaksanaan, observasi dan refleksi. Subjek penelitian ini adalah peserta didik kelas lima SD Negeri. Instrumen yang digunakan tes tertulis dan observasi. Semua data dianalisis secara deskriptif kuantitatif kualitatif. Pada siklus I mencapai nilai rata-rata 76.7 akan tetapi peserta didik masih membutuhkan manajemen dalam kolaborasi menyelesaikan proyek. Pada siklus II diperoleh nilai rata-rata 87 dan peserta didik mampu membangun kolaborasi dalam menyelesaikan proyek. Aktivitas ini dibantu dengan sumber belajar berupa lembar kerja proyek, lembar diskusi, poster, lembar demonstrasi, dan media lembar pengayaan bebas pilih bagi peserta didik. Berdasarkan hasil siklus I dan II dapat disimpulkan bahwa peningkatan hasil belajar peserta didik dipengaruhi oleh model pembelajaran berbasis proyek yang didalamnya peserta didik dapat berpikir kritis, memecahkan masalah, menuangkan ide-ide baru, berkreasi, aktif berinteraksi dan komunikasi antar kelompok.

## INTRODUCTION

Learning is an activity that builds interaction between teachers and students in the process of achieving the learning goals of gathering information, determining its relevance, and combining it with existing knowledge to rebuild knowledge (Ginting, 2021). New-era learning is currently an opportunity and a challenge for students because it follows developments in the times that require students to achieve learning outcomes and skills, including critical thinking, communication, collaboration, and creativity. The influence of academic capability on the students learning outcomes had showed the significance values in cognitive, psychomotor, and affective domains (Supena et al., 2021). Thus, learning leads to project-based activities to build students' skills.

Learning outcomes are students' ability to build interactional goal activities that liberate students who achieve forms of behavioral change that tend to persist, demonstrate the potential of incorporating an automated, interactive feedback tool supported by artificial intelligence to create effective including cognitive, affective, and psychomotor (Copur-Gencturk et al., 2024). During the learning process over a certain period, it is hoped that changes in learning outcomes will be reviewed by consistency, organizing processes, thinking processes, and problem-solving in the form of learning outcomes (Sutrisno et al., 2020). It will increase students' enthusiasm for learning so that students' motivation and interest in learning will result in achieving learning objectives (Rahaf et al., 2024).

It is important to know that the influence of improving learning outcomes cannot be separated from implementation activities, learning resources, school environment, and school culture's need for innovation, views about innovative approaches to instruction, responsiveness to instructional innovations, and the perceived

implementation level of educational innovations (Caliskan & Zhu, 2020);(Wu & Yang, 2022). Science learning is essentially learning, and its implications for school practice provide direct learning experiences through scientific process skills. Therefore, innovative learning models are needed in science learning at the elementary school level (Darling-Hammond et al., 2024). Through innovative and creative learning models, it is hoped that students can directly experience, create, and develop their understanding of knowledge through teacher monitoring and guidance so that learning objectives are achieved.

Based on Radović et al. (2024), students often have poor self-regulation practices, lack reflective thinking, and fail to monitor their learning against the defined goals of previous research on extrinsic factors. There are differences in the average score of low learning outcomes, a lack of collaborative activities between students, and the treatment of strategies, techniques, methods, and learning models that do not involve inter-group activities. Internal factors include physical and psychological factors in students, such as interests, intelligence, talents, intelligence levels, and other factors. External factors include environment and instruments such as curriculum, programs, facilities, methods, models, and strategies (Jannah et al., 2024). The intrinsic factors found are the characteristics of students who are not active in learning due to a bad mood, such as sleepiness and boredom, how their emotional maturity impacts students' learning outcomes as well as a lack of interest and motivation in the subjects being taught (Le & Pham, 2024). This is the main problem with how teachers teach, which influences student learning outcomes. An important research line has focused on the mechanisms explaining how teacher-student interactions affect several behaviors, from intrinsic motivation to demotivation, intrinsic motivation being the most closely

linked with adaptive behavioral outcomes, and demotivation understood as a lack of interest to engage in a certain behavior (Franco et al., 2023).

Therefore, innovation in learning activities is needed to increase students' learning activities, including cooperation and groups. Using group work techniques has increased student learning activity, increasing interest in learning, learning that is not boring, and implementing learning models that are pro-student so that they can improve students' learning outcomes (Saufi et al., 2023). Learning activities through project-based learning involve collaborative assessment in solving an authentic problem through a process of integrating knowledge, application, and construction so that it will create a learning center between students providing feedback on learning. In this situation, educators may receive insufficient student feedback to modify and optimize their teaching and learning approaches regarding learning motivation and cognitive outcomes (Guo et al., 2020);(Chan & Smith, 2024).

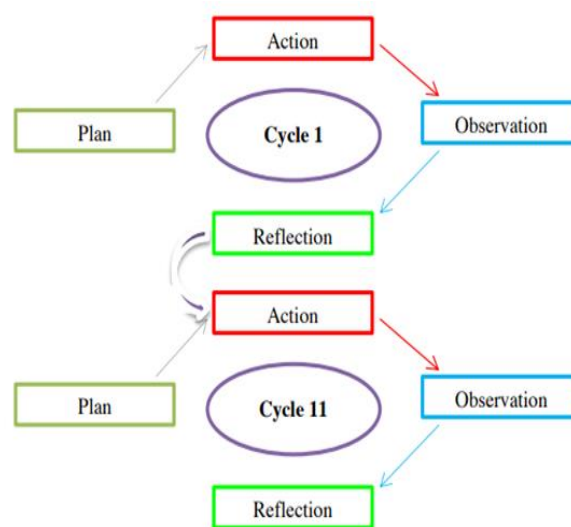
Through the implementation of an activity-based learning model, potential is developed by actively participating in the learning process according to individual desires and needs. This approach incorporates a scientific inquiry learning model, specifically Project-Based Learning. The Project-Based Learning science intervention focuses on third graders' academic, social, and emotional learning. This intervention includes four science units and materials, professional development sessions, post-unit assessments, and features of project-based learning aligned with three-dimensional learning principles (Krajcik et al., 2023). Project-based learning is a process of direct involvement of students in producing products from the results of solving problems (Ling et al., 2024). Students are directly involved in working on projects and meaningful task-discussion activities. Students are given the

opportunity to construct their learning activities, especially on the learning topic "How Breathing Helps Me Do Activities Every Day" and the learning topic "How Do I Grow Up?" with the aim of making it easier for students to understand the material directly so that there is potential to increase student learning outcomes.

## METHOD

This research was conducted at SD Negeri (State Elementary School) 130 Palembang. Twenty-two fifth-grade students were the subjects of this research. This study uses the Classroom Action Research method to improve the quality of the implementation of the learning process. This study uses the Kurt Lewin model, which is in the form of a spiral with planning, acting, observing, and reflecting in two cycles.

At the planning stage, the researchers prepared teaching modules, worksheets, learning videos, learning media, and evaluation instruments. At the implementation stage, the model teacher implements the teaching module according to the plan. At the observation stage, all research members observed the learning process. At the evaluation stage, reflection is carried out on implementation. The following is the classroom action research cycle:



**Figure 1.** Classroom Action Research Cycle

Figure 1 is a class action research cycle from Yampap et al. (2019). The data collection techniques used consisted of tests and observations. Test instruments are used to measure student learning outcomes. The form of this research test is a description consisting of five questions. Observation instruments are used to observe student activities. The data analysis technique used in this research is descriptive quantitative based on test data, while the observation data is analyzed descriptively qualitatively.

## **RESULTS AND DISCUSSION**

### **Plans I**

In Cycle I, the model teacher discusses the topic "How Breathing Helps Me Do My Daily Activities" with the learning objectives so that students can (1) Predict the consequences if humans do not breathe, (2) Describe the respiratory mechanism in humans, and (3) Reflecting the importance of maintaining the health of respiratory organs.

The learning media used in cycle I used conventional and technology-based media. The model teacher uses media in the form of learning videos related to the breathing system. Furthermore, the teacher uses conventional media for practical activities carried out by students, namely breathing props, which require tools and materials in the form of (used 1.5-liter bottles, plasticine, solvents, rubber bands), rubber balloons, and straws) are learning media, such as "Human respiratory system teaching aids."

Apart from that, the learning media used by teachers is a technology-based model to support teaching and learning activities, namely learning videos to make it easier for students to understand audiovisual learning outcomes and using PowerPoint to make it easier for teachers to deliver more creative and innovative material to attract students' learning attention.

The model teacher prepares student worksheets in the form of discussion sheets and practical sheets to support project activities carried out on the topic "respiratory system in humans." The teacher uses a learning model that supports activities, supports students, and achieves learning objectives; the model teacher uses the project basic learning model. Apart from that, the model teacher prepares evaluation instruments in the form of test instruments, observation sheets, practical sheets, and discussion sheets to improve the skills of the project results created.

### **Action I**

On February 26, 2024, at State Elementary School 130 Palembang, the model teacher carried out research at the fifth-grade level. The implementation stage begins with opening activities, core activities, and closing activities. In the introductory activity, the teacher begins by inviting students to pray before studying and carrying out good practice habits in the classroom, such as keeping their hair clean. Next, the teacher conveys the learning objectives on the topic "How does breathing help me carry out daily activities?" through the question, "What are the organs that play an important role in breathing?" so that teachers and students begin to build interaction and collaboration to discuss when starting teaching and learning activities.

Then, in the core activity, the teacher invites students to determine the main problem question by starting with literacy activities with pictures and narration from learning videos and observing the surrounding environment in connection with integrating the topics discussed so as to foster students' curiosity about learning. Then, the teacher asks students to divide into groups to plan a project based on the teacher's direction from the worksheet provided so that students can collaborate and explore the respiratory system teaching

aids that are being made so that students understand the concept of respiratory organs and the mechanisms of the respiratory system in maturity. Projects, namely breathing props and respiratory system posters, so that students can allocate time to preparing activities and completing projects.

During project completion, the teacher guides and monitors the progress of project completion, such as students' progress in completing the project according to the worksheet instructions provided, and carries out assessments related to project work. When finished, each group is asked to present and test the results of the project completion. After that, evaluation and reflection on the process and results of the project will be carried out to obtain feedback from the teacher and the results of joint discussions in class. Entering the closing activity, teachers and students practice good habits, namely cleaning the classroom environment before going home and then praying together.

## Observations I

### Observation Activities

Based on the results of the observation, it is necessary to divide groups for students because it is too large to cause misconceptions in understanding project completion. This is a concrete factor in students' learning conditions, the need for involvement between group members so that there is no gap in interaction and cooperation, it is necessary to divide groups again according to student characteristics. As for observers three and four, several groups need to be given special treatment in the form of guidance in completing projects.

Observation results also show that the number of student groups is too large, making it difficult for students to interact and collaborate in completing projects, so that there are several groups that need to be re-mapped into homogeneous groups. Therefore, teachers need to provide

guidance and monitor the needs of students who have characteristics due to differences of opinion when working on students' worksheets and not wanting to share assignments.

Then, the teacher tries to encourage students' activeness in taking part in teaching and learning activities, starting to motivate students to be actively involved. The teacher checks and monitors the project activities of each group through collaborative interactions by providing feedback on questions to the teacher so that student's learning needs are created, and their learning is not missed. The division of performance determines learning success and project completion for students while maintaining students' learning concentration.

The most valuable learning observations are based on the results of the first observer, who found that the division of tasks determines students' learning success. The second observer's results showed that determining the study group influenced the activities and giving students worksheets influenced the assessment questions. The third and fourth observers supported the statement that teachers must maintain students' learning concentration.



**Figure 2.** Respiratory System Teaching Aid project

Based on the picture above, the Respiratory system teaching aid project, from the learning activities in the cycle, based on the results of observations that learning has shown student-centered activities and good immersion, and it is necessary to manage study groups through the implementation of the project-based learning model for natural science subjects at the fifth-grade level, it is hoped that this can improve results. Study and next meeting.

### Cycle I Cognitive Learning Results

In the learning activity on the topic "How Breathing Helps Me Do My Daily Activities," the following are the cognitive learning results after evaluation using test instruments with the types of questions described in the table below:

**Table 1.** Student Cognitive Results in Cycle I

Value Range	Category	Amount	Percentage (%)
89-100	Excellent	2	9
77-88	High	8	36
65-76	Moderate	12	55
<65	Low	0	0
<b>Amount</b>		<b>22</b>	<b>100%</b>
<b>KKM</b>		<b>65</b>	

Based on Table 1.1, the cognitive learning results in the first cycle obtained by students show that nine percent achieved excellent results, meaning two people achieved learning, and thirty-six percent, consisting of eight people, achieved good learning results. Fifty-five percent of the participants were twelve people who obtained sufficient learning outcomes, while there were no scores less than the minimum completeness criteria.

### Reflections I

At the reflection stage, after conducting research, the teacher must understand the characteristics of different students and the varied needs of students and realize freedom of learning. Model teachers must design according to the needs

and characteristics of students by providing guidance to tutor teachers and being observers in guided learning practices. When conditioning the class when students are noisy, they lack focus in learning, and the division of study groups must be proportional. Therefore, this is certainly useful to condition the class, but on the other hand, there are more appropriate ways to provide good advice and delivery. All learning processes are useful for students, and I carry out ice-breaking activities, which are also necessary so that students can refocus and motivate themselves in learning.

As a good practice step before learning begins, students clean according to the picket schedule to make the class clean and comfortable during the learning process. Students pray before learning begins. Learning is carried out actively through collaboration between teachers and students, as well as the integration of interactive learning models and media to achieve learning objectives on the topic "Breathing helps me carry out daily activities." From the teacher's explanation, the students made a breathing props project. Then, at the end of the lesson, the students were able to answer the evaluation questions given by the teacher so that the teacher could see to what extent the students understood today's learning material. This happens so that the stimulus for students to understand how to care for the surrounding environment, and students will have the skills to think critically and creatively and have a spirit of collaboration and cooperation so that these solutions can be translated into everyday life. In achieving learning objectives, the use of media or learning models implemented in delivering material will increase students' enthusiasm for learning so that students' motivation and interest in learning can improve their learning outcomes.

## **Plans II**

At the planning stage, the model teacher prepares learning tools consisting of teaching modules, student worksheets, learning media, and evaluation instruments. The learning model used is project-based learning, which actively involves students in practical activities in the form of puberty glasses. Apart from that, this learning mode is to improve students' skills.

Meanwhile, the learning media planning used is puberty glass project tools, recycling-based teaching aids in the form of mineral water glasses, and pictures of puberty changes. This puberty glasses project helps in achieving learning objectives.

The model teacher also prepares student activity sheets consisting of discussion sheets and practical sheets to support active learning in making a puberty glasses project with activities to recognize changes and characteristics of entering puberty besides being supported by learning videos aimed at students being able to understand the differences. Human growth and development, characteristics of puberty based on gender.

So, at this stage, the model teacher also prepares evaluation instruments in the form of test instruments, student discussion worksheet results, and observation sheets. In this second cycle, at the test results evaluation stage, the test is given using the appropriate procedures from (Sari et al. (2023) to see learning outcomes, worksheets, and practicum sheets to see students' skills.

## **Action II**

Implementation of cycle 2 will be on March 18, 2024, at Junior High School for class V science subject "How do I grow up?" The implementation stage begins with opening activities, core activities, and closing activities. In the opening activity, the model teacher conducted an apperception and conveyed the learning objective "How Will I Grow Up?" through learning project

media, technology-based learning media in the form of learning videos, and other videos to support learning activities.

Next, the model teacher chooses the appropriate learning mode to achieve the learning objectives so that learning is centered on students increasing the attitude of collaboration through the results of the project created in the form of "puberty glass" demonstration media. This learning model consists of six syntaxes, namely, inviting students to determine the main question or problem. Students plan the project, make a schedule for project completion, monitor the progress of project completion, present and test the results of project completion, and evaluate and reflect on the process and results of the project.

In the introductory activity, the teacher prepares himself and the students before starting the learning activity, starting with prayer and presenting the topic and learning objectives. The teacher asks a trigger question, "How do I grow up?" and "What organs play an important role in human growth and development?" so that discussion and feedback activities arise between teachers and students.

In the core activities, the teacher prepares literacy materials based on the learning topic and then asks students to determine problem questions to explore understanding "How does the body experience growth and experience puberty?" so that students need to dig up more information with collaborative activities and discussions that cannot be separated from guidance, the teacher invites students to plan a project which aims to ensure that students have a strengthened concept regarding the growth process and puberty through a project created before the students' project planning is directed from (Windari et al., 2023) to watch learning videos about readiness to face the body and puberty period with the hope of improving learning outcomes.

After planning the project and engaging in self-concept elaboration activities, students begin to develop strategies for planning and completing the project according to the teacher's direction. For example, they will make "Puberty Glasses" because the teacher will monitor the progress and completion of the pubescence glass project and assess the work. Then, the students present the results of their projects in each group.

Continuing with reflection activities for teachers and students to get feedback from the results of learning project activities which foster motivation so that they can increase knowledge of cognitive learning outcomes through games, namely "free choice" because Restanti et al. (2023) said provides learning resources and additional activities through activities. The group solves the questions to stimulate thinking skills and efforts to improve student learning outcomes.

After the core learning activities are completed, in the closing activity, the teacher and students carry out evaluation activities to see the students' learning outcomes; after that, they carry out ice-breaking activities, which are reflected in the learning objectives. Meanwhile, after the activity, the teacher instills good practices and good habits before ending the lesson, such as cleaning the classroom environment, and then continuing to pray after learning.

## Observations II

### Results of Cycle II Observation Sheet

Based on the results of observations related to student participation in learning, it is necessary to pay attention to the implementation of learning objectives that will be achieved through adjusting the time allocation of students' enthusiasm in participating in learning activities, based on concrete factors of students' learning conditions, teachers continue to carry out monitoring and guidance because there is one of the students. Special guidance is

needed because of the distractions during project activities; this is due to differences in learning characteristics with group members; the teacher continues to build a classroom gym that is comfortable and enjoyable during learning activities with the encouragement of working together between groups to minimize distractions between individuals and groups.



**Figure 3.** Puberty Glass Manufacturing Work Project

Based on the picture above, the completion of projects carried out by students in collaboration cannot be separated from the role of teachers who have tried to encourage student activity, starting from monitoring, guiding, and nurturing students, seeing the progress of media projects being carried out, pouring out new ideas, and creativity through "puberty glasses," So the importance of monitoring and adjusting the achievement of learning objectives.



**Figure 4.** Students play collaborative games freely.

Based on the picture above, students based on the picture above's activities



provide questions that must be answered in collaboration with the "Free to Choose" sheet, which is an added value for students.

So, based on observations in cycle II, the model teacher must try to monitor the achievement of learning objectives and increase knowledge. By describing the growth process, students can identify whether they have entered puberty or not. This collaborative activity spearheads students' critical thinking through the application of the project-based learning model.

### Cycle II Cognitive Learning Results

In the learning activity on the topic "How Did I Grow Up?" the following are the cognitive learning results after evaluation using test instruments with the types of questions described in the table below:

**Table 2.** Student Cognitive Results in Cycle II

Value Range	Category	Amount	Percentage (%)
89-100	Excellent	7	32
77-88	High	15	47
65-76	Moderate	0	21
<65	Low	0	0
<b>Amount</b>		22	
<b>KKM</b>		65	<b>100</b>

Based on Table 1.2, the cognitive learning results in the second cycle obtained by students show that thirty-two percent achieved excellent results, meaning seven people achieved learning, and forty-seven percent, consisting of fifteen people, achieved good learning results. Then, there is zero percent, meaning that no one got sufficient learning results, while there are no scores less than the minimum completeness criteria.

### Reflections II

Experience in implementing the project-based learning model requires planning learning according to the needs and characteristics of students by guiding stakeholders and scientific studies and activities during teaching and learning

activities to condition the class when students are noisy and less focused on learning. The division of study groups must be proportional. This is necessary so that students can refocus and motivate themselves in learning through learning experiences, namely before learning begins, by building class comfort and good practice before starting learning. Learning is carried out actively through collaboration between teachers and students as well as the integration of interactive learning models and media to achieve learning objectives on the Topic "How Do I Grow Up?" Through the teacher's explanation, students make puberty glass media. Then, at the end of the lesson, students can answer the evaluation questions given by the teacher so that the teacher can see to what extent students understand today's learning material by having critical and creative thinking skills and having a spirit of collaboration and cooperation so that these solutions can be translated into everyday life.

This cannot be separated from the learning model used, namely, the project-based learning model, which is appropriate for student-centered learning activities and creating learning media projects; the model teacher carries out teaching optimally, both in terms of achieving learning objectives and using media or learning models, which is implemented in the delivery of material.

The discussion in this research compares changes in the level of achievement of student learning outcomes using the project-based learning model. This was done to determine the improvement in learning outcomes of fifth-grade students in science subjects, which improved students' learning outcomes positively (Zhang & Ma, 2023). The basis for this research is to determine the increase in learning outcomes in each cycle of learning implementation using the Project Based Learning mode.

The results of the observations made by stakeholders show that model teachers experience changes in the learning process

in the classroom. In the cycle, I, the teacher, implemented a learning model and only provided project worksheets and discussions. There were no activities for solving questions and reflection based on active collaboration, so activities in managing and processing cognitive results of students had not fully mastered the dominant learning objectives, which had a value of 65- 77, which is the sufficient limit for the Minimum Completeness Criteria (KKM). Apart from that, the division of groups is not homogeneous, and the scale is too large, so the achievements obtained by each individual are not optimal, and the project is not given.

Meanwhile, in cycle II, the implementation of Project-based learning is then given project work activities because an activity emphasizes contextual learning in complex activities starting from demonstrations producing independent skill products, group discussion activities, and model teachers adding activities that encourage participants students to be more active in solving problems and more interested in working on reflections before evaluation activities, namely the "Free to Choose" activity (Rosita et al., 2024);(Pitorini et al., 2024). Each group works on questions through collaboration, and teamwork is required because this can improve communication skills and make precise decisions regarding questions and responsibilities (Likita, 2020). Facilitates whole-class knowledge development while also allowing greater opportunities for students' teamwork and communication skills development in a competency-based education context, which can increase students' activeness, interest, and learning motivation (Pollock et al., 2023). The results of observations show an increase in students' learning activities in terms of working together to complete projects, discussion activities, and problem-solving in the form of questions given by the teacher with tendency, learning achievement, and

collaboration tendencies were evaluated (Zhang & Hwang, 2023);(Handoko et al., 2024). So, the results obtained in the evaluation in cycle II are in a high category, namely the value range 77-88. The minimum completeness criteria given is 65, meaning that cycle II shows a change in the completion of the project because Lestari et al. (2023) said the interest in project activities is mutual care, openness, and a high sense of curiosity, from Kurniati et al. (2022) shows an attitude critical thinking. Apart from that, Rajić (2024) project activities aim to build responsibility, commitment to learning, and analysis to complete the project so that it can improve student learning outcomes.

After implementing the project-based learning model in each cycle, student learning outcomes increased. The class average experienced an increase every cycle. In the first cycle, the class average was 76.7, which was still a sufficient KKM score with a score range of 65-77 and a dominant success percentage of 55%. Meanwhile, in cycle II, it has exceeded the minimum completeness score and has exceeded the action percentage, namely 79%, with a score of >77, so the score achieved by students has exceeded the KKM score, which is in the high and excellent categories. with an average grade score of 87.

## **CONCLUSIONS AND SUGGESTIONS**

The results of the research are an effort to improve student learning outcomes using a project-based learning model in science and technology subjects at the elementary school level. During the implementation of the two cycles using the same learning model, namely the project-based learning model, to increase cognitive learning outcomes obtained based on test results, the assessment results obtained increased from cycle I to cycle II. In this case, the average score of students from the sufficient category, namely the percentage, was 55% with an average of 76.7, while in

cycle II, it increased to high and better, namely 79%. With an average of 87. This cannot be separated from observation activities in that classroom management efforts, study group management, and consistency use a project-based learning model and are integrated with learning resources and the use of media that supports interest and motivation and builds student cooperation through media modification. In the form of a "free to choose" collaborative assessment, students are encouraged to solve problems and increase their learning outcomes. Learning builds collaboration to solve a problem so that students are more active independently and in groups when completing projects. So, during the evaluation activities, students' learning outcomes experienced an increase in terms of their activeness, collaboration, project completion, and scores exceeding the minimum completeness criteria value.

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