

IMPLEMENTATION OF THE PROJECT-BASED DIFFERENTIATED LEARNING MODEL IN SCIENCE AND SOCIAL SCIENCES (IPAS)

Muhammad Rifqi Izzul Haq¹, Moch. Bahak Udin By Arifin^{*,2}

^{1,2}Universitas Muhammadiyah Sidoarjo

Email: rifqi130501@gmail.com, bahak.udin@umsida.ac.id*

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Abstract.

Abs Research on the Application of Project-Based Differentiated Learning Models in Natural Sciences and Social Sciences (IPAS) Learning is motivated by the low percentage of student learning success and low student creativity in learning. So, this research was prepared to find out how to implement and effectively apply the project-based differentiation learning model in science and science learning. This research was carried out during two meetings starting on 28 October 2023 and 31 October 2023, with a research population of class IV students at MI Muhammadiyah 2 Kedungbanteng Tanggulangin totaling 18 students, consisting of 10 male students and eight female students. The method used by researchers is a one-group pretest-posttest quantitative experimental method. From the research results, the average student pretest score was 59.6%, and the average student posttest score was 70.8%. It can be concluded that the implementation and effectiveness of the Project Based Learning Differentiated learning model is better compared to direct science and social studies learning (IPAS).



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A. INTRODUCTION

The learning model is a design that shows the process and creates environmental conditions so that students can relate, change and develop (Hasriadi, 2022). The learning model is also a form of general pattern to achieve the expected learning objectives (Khoerunnisa & Aqwal, 2020). The function of the learning model is to realize the learning objectives that have been set by the educator. Thus, the learning model must consider the learning objectives. Learning models can be fun for students and there are elements that influence learning (Nurdyansyah, Udin, & Alfian Rosid, 2021).

The characteristics of a learning model are the distinctive features of a model that is implemented in stages (Khosiah, Fadilah, & Zainab, 2023). The learning model has the following characteristics; 1). Syntak is the beginning of the learning steps that show how the model is implemented. Syntak is characteristic for each learning model, which means that syntak compares the differences between models and other models. 2). Social system is a rule that regulates the form of approach or interaction between students and teachers and between students and students. The form of interaction of learning activities will never be separated from the social

interactions that exist in that class. 3). The reaction principle is the teacher's behavior towards students during learning activities. 4). The support system is the resources needed to support the implementation of learning activities using the model that has been prepared. 5). Model impact or model effect is the result obtained after learning by using learning models. The impact of the model has two types; 1). The instructional impact of the impact caused by the achievement of the objectives of the learning models. 2). The follow-up impact is the impact of achieving goals that were not previously planned (Hendracita, 2021). Model is a pattern or form that becomes a reference in implementation. The learning model is basically a form of learning from start to finish that has been prepared by the teacher (Sulisto & Haryanti, 2022). The elements of the learning model 1). Systematic, 2). Social system, 3). The principle of reaction, 4). Support system, 5). Instructional and accompanying effects.

Differentiated learning is a process of learning students to learn content based on their talents, with what they like and their special needs (Gusteti & Neviyarni, 2022). The purpose of differentiated learning is to assist students in learning, increase students' learning motivation and learning outcomes, establish good relationships between teachers and students, help students become responsible and independent learners, and increase teacher satisfaction (Marlina, 2019). Differentiation also helps students be more

confident and can express their opinions about learning (Avandra & Desyandri, 2023). The differentiated approach consists of three components: content differentiation, process differentiation, and product differentiation (Ayu Sri Wahyuni, 2022). 1. Content differentiation relates to the curriculum and student learning materials to be studied. In this case, teachers modify the curriculum and learning materials based on students' learning interests and learning needs. The curriculum content is adapted to students' learning styles and abilities. 2. Process differentiation is the way students process learning ideas and information, as students interact with materials to determine student learning choices according to student learning styles and interests. 3. Product differentiation is how students show what learning outcomes have been obtained or learned. Learning products can help teachers assess what students have mastered and provide further material. And the student's learning style can determine the student's learning outcomes that will be shown to the teacher.

The differentiated learning model requires students to attend school, and the school facilitates students in terms of psychology, technology that is achieved and accustoming that fosters the character of students (Kristiani et al., 2021). At the time of differentiated learning, educators adjust to the readiness and interest of student learning (Wahyuningsari, Mujiwati, Hilmiyah, Kusumawardani, & Sari, 2022). educators

must provide the needs needed by students through stages that have been prepared (Pramudianti, Huda, Kusumaningsih, & Wati, 2023) The stages of the differentiated learning model to be studied include (Mamkua, 2023). : 1.) Create an effective, positive and ethical learning environment. The learning environment is created with conditions that meet the criteria in the classroom. Examples of zones that meet classroom criteria, attendance zones, emoticon zones, student gallery zones, reading corner zones, and class agreement zones. 2.) preparing students' personal and social skills through offline learning by inviting teachers as resource persons so that students have, self-awareness, self-management, social awareness, and social management. 3.) each subject conducts a diagnosis test in the form of description questions to obtain students' competencies through written, visual, and audio-visual tests prepared by the teacher to see students' learning readiness. To obtain data on learning styles and learning interests of students can be taken with the previous test, then given a questionnaire through student learning outcomes. The results of this diagnostic assessment become the basis for planning activities for content, process and product differentiation design. The flow of the project-based differentiated learning model includes diagnosis assessment - student identification - content differentiation and process differentiation - product differentiation. 4.) Prepare information and

communication technology that meets the criteria for online-based classes so that students have social and ethical procedures for using information and communication technology (ICT), investigate through ICT, communicate and information through ICT, can manage and operate ICT. 5.) Prepare project-based learning according to the subject. With project-based subjects can provide learning space for students to explore the surrounding environment and train students' mindset critically and can solve problems. Preparation of project-based learning as follows, the teacher plans the project that students will do and sets the project theme according to the subject and determines the related KD. Differentiated learning also has positive properties for students and teachers because students are more interactive and creative (Elviya & Sukartiningsih, 2023). The importance of the differentiated learning model in the era of the independent curriculum is to improve student learning outcomes and facilitate the learning process according to the learning needs of students (Insani & Munandar, 2023).

There are several previous studies that discuss project-based learning models. The problem-based learning model is a learning process that starts with solving problems, but to solve problems students need extensive knowledge to solve problems in their environment. (Sarie, 2022). The problem-based learning method is a way of learning students to a problem to be solved or resolved in relation to open problems in

learning (Hotimah, 2020). This problem-based learning model uses an initial diagnosis, designs learning implementation (RPP), differentiates with a problem-based learning (PBL) model, implements learning activities and evaluates learning outcomes. However, the shortcomings of the problem-based learning model studied by Sarie, Fitria Novita are that students only carry out this process with theories and phenomena. Where students only get knowledge from book sources that have been prepared by the teacher. It would be better if the problem-based learning model is carried out by experimenting or directly so that students get knowledge directly and add to the experience of students in solving their problems. Problems researchers are interested in conducting research by comparing the differences between two models, Problem Based Learning Model, Researchers use the implementation of project-based differentiated learning models in IPAS learning to see differences in models to determine the results and experience of solving student learning problems.

Project-based learning model is a learning model adapted to develop students' creativity and learning skills through research activities and produce certain products (Eni, 2022). The shortcomings of the research researched by eni project-based learning models not only increase student creativity but can improve student learning and experience. With a good learning environment, the student learning process

will run well and foster a good sense of learning for students. It would be better if the project-based learning model is implemented in groups so that students work more together in developing students' creativity and skills. The problem is that researchers are interested in conducting research by comparing the differences between two models, project-based learning learning models to improve student creativity in listosphere material. Researchers use the implementation of project-based differentiated learning models in IPAS learning to see differences in models to determine student learning outcomes.

Students' ability to think critically with a learning-based learning model is a project-based learning model using learning media. Students are guided to explore, assess, understand and information in groups that are able to solve problems in the learning process (Pratiwi & Setyaningtyas, 2020). Researchers' shortcomings in students' ability to think critically with a project-based learning model students only study with theory and phenomena or media studied. Student learning outcomes are also very important in project-based learning and can also assess students in solving problems faced by students. It would be better if students' thinking skills are directed using real projects in order to increase students' experience more critically. The problem researchers are interested in conducting research by comparing two different models. Students' ability to think critically with a learning-based learning model. Researchers

used the implementation of a project-based differentiated learning model in IPAS learning to see the difference in models to see student learning.

Analysis of the application of project-based learning and problem-based learning models is a project work where students work individually in learning and foster student creativity in learning (Setiawan, Sumilat, Paruntu, & Monigir, 2022). The learning model influences the thinking efforts of students to solve problems in learning in achieving learning objectives. The project-based learning model is a learning outcome of student learning to determine student creativity and student ability. The shortcomings of researcher students only study with individuals. It would be better if students learn by working together in order to increase student learning outcomes with differences in opinion. The problem of researchers interested in conducting research by comparing two different models. Analysis of the application of project-based learning and problem-based learning in elementary school students. Researchers use the implementation of project-based differentiated learning models in IPAS learning to see the difference in models to see student learning outcomes.

The application of the cooperative learning model of group investigation type to improve the learning outcomes of natural science IV sd GMIM 2 Woloan (Lestari, 2022). cooperative learning model of group investigation type to improve student

learning outcomes and teachers form groups of students to work together in learning in order to understand the material better and be able to solve problems in every lesson. The researcher's shortcoming is whether each group member really understands the learning and it would be better if the teacher asks individual group questions whether the learning can be understood well. Researchers are interested in comparing two different models. The application of cooperative learning model type group investigation to improve the learning outcomes of natural science of fourth grade students of GMIM 2 Woloan Elementary School. Researchers use the implementation of project-based differentiated learning models in IPAS learning to see the difference in models to see the competence of project-based technology pedagogy.

The importance of this research is not only to provide experience to students but with the projects of students can increase broad knowledge and improve student learning outcomes and so that students' learning styles are well directed (Himmah & Nugraheni, 2023). Implementation is a process that will be carried out to be tested on students (Nisa & Nurdyansyah, 2023). In the project-based differentiated learning model can be seen from the process of creativity and student activity, in this process the learning process will have an impact on increasing student learning outcomes. Project-based learning also has a very broad potential to improve students' learning experience and

improve students' learning outcomes by preparing the learning environment and preparing the learning process according to the theme and project to be studied. Project-based learning (PBL) is a project that supports learners in improving their skills and experiences (Khasanah & Darsinah, 2022). So the differentiated learning model is very important to increase students' interest in learning and readiness to learn to make projects according to their learning needs (Pane, Lumbantoruan, & Simanjuntak, 2022). Projects can be done by creating learning media or written works according to students' abilities (Nurdyansyah, Wahid, Nuzulia, & Bahak Udin By Arifin, 2020).

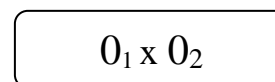
This study aims to determine how the implementation of project-based differentiated learning models in natural and social science learning at MI Muhammadiyah 2 Kedungbanteng Tanggulangin and how the effectiveness of the implementation of project-based differentiated learning models in natural and social science learning at MI Muhammadiyah 2 Kedungbanteng Tanggulangin.

B. RESEARCH METHOD

The approach used in this research is quantitative research method with experimental quantitative method. Experimentation can be interpreted as a research method that is used to look for certain effects or treatments on others under controlled conditions. The quantitative

research method of experiments One-Group Pretests-Posttest Design (pseudo-experiment) this design has pretests and posttests, before being given treatment. Thus the results of the treatment can be known more accurately because it can compare with the situation before being treated (Sugiyono, 2016). This design is described as follows,

Figure. 1.1 One-Group Pretest-Posttest Design



O₁ : Pretest score (before given training)

O₂ : Posttest score (after given training)

The effect of training on student achievement: (O₁ – O₂)

Sources of data obtained through primary data with data sampling methods containing tests and student observations. by making written statements given to respondents who are answered in writing. By means of calculations that use interval and ratio scales. The interval scale is a numerical scale measurement that is close together and has the same distance and is measured by a scale. The ratio scale is a quantitative data measurement scale that makes it easy to find differences between variables and data order. Secondary data are school documents and the results of observations of students under study.

The data collected from this study consisted of the Implementation of Project-Based Differentiated Learning Models in Natural and Social Science Learning (IPAS) at MI Muhammadiyah 2 Kedungbanteng,

Tanggulangin. Population is a generalization area consisting of objects or subjects that have certain qualities set by researchers to study and then draw conclusions. The population or sample in this study were 4th grade students at MI Muhammadiyah 2 Kedungbanteng school, Tanggulangin. The research sample in this study used purposive sampling technique, not giving the same opportunity to the entire population.

Data collection techniques used in this study; a). The test that will be used by researchers is the difference in the results of students' pretests and posttests using a ratio and interval scale. Pretest results are carried out by students in natural and social science learning, and posttest results are carried out by students in the implementation of a project-based differentiated learning model. b). Observation (observation) which will be used is the result of sampling pretest and posttest data. pretest conducted by students in natural and social science learning and posttest results conducted by students in the implementation of project-based differentiated learning models. c). Documentation (school documents) which will be used to obtain data and information in the form of books, archives, documents, written numbers and images in the form of reports can support the results of the pretest and posttest research.

The data analysis that will be used by researchers is a). T test (T Test), independent sample t test is used to determine whether there is a difference in the average of two

unpaired samples. The data used in the independent sample t test is quantitative data in the form of ratio and interval scales, the main requirements for the independent sample t test are normally distributed and homogeneous (not absolute), from the results of the normality test analysis and the homogeneity test the conclusions obtained are normally distributed and homogeneous. The normality test is conducted to find out whether the data under study is normally distributed or not, the normality test is a test with statistical analysis requirements or basic test analysis. The basis for making normality test decisions 1). If sig (significant) or probability value < 0.05 . Then the data is not normally distributed. 2). If sig or probability value > 0.05 . Then the data is normally distributed. The homogeneity test is used to determine whether the population variants are the same or not. Homogeneity is not a requirement in the independent sample t test because, if the group variance is homogeneous, it can produce accurate measurements in the difference test. Decision making in the homogeneity test 1). If sig (significant) based on mean > 0.05 . Then the data variance is homogeneous. 2). If the significant value based on mean < 0.05 . Then the data variance is not homogeneous. The independent sample t test in this study was used to answer the formulation of the problem, whether there are differences in student learning outcomes in natural and social science learning between the learning outcomes of students who use the

implementation of project-based differentiated learning models.

Table 1.1 Observation Assessment

Indicators	
Indicators	Persentase
Very Good	90% - 100%
Good	80% - 90%
Pretty Good	70% - 80%
Not Good	60% - 70%

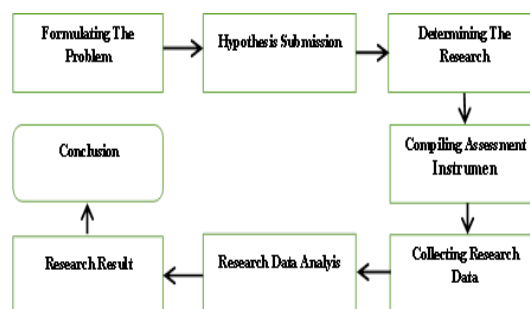
Analysis of observation data using table 1.1 observation research indicators to determine whether the implementation of project-based differentiated learning models in natural and social science learning (IPAS) at MI Muhammadiyah 2 Kedungbanteng Tanggulangin has been carried out properly.

Documentation used to obtain data or documents on the results of student observations through pretests and posttests that have been studied, in the form of pictures of the process of observing, recording, and processing data in the form of photo attachments of the results of the student pretest and posttest observation process to strengthen the results of the study.

Steps of the research process 1). Formulating the problem The first step in conducting quantitative research is to formulate and define the problem, researchers use pretests and posttests by comparing differences in natural and social science learning between the implementation of project-based differentiated learning models. 2). Hypothesis submission, hypothesis formulation questions or temporary conjectures, how to hypothesize is

to review previous research, researchers review problem-based learning (PBL). 3). Determining the research method, this step is carried out for simplification and strategy, researchers use an experimental quantitative method approach. 4). Compiling assessment instruments, this step requires research data or data sampling with appropriate methods, researchers use test strategies, observation and documentation. 5). Collecting research data, collecting from data sampling in the form of tests, observations, and documentation. 6). Research data analysis, the process of processing data and information that has been obtained during the research. 7). Research results, review of the validity of the research results. 8). Conclusions are drawn from the data that has been processed and analyzed, then the information obtained is used to make conclusions from the conclusions of the formulation of problems and hypotheses that will be tested for truth.

Figure 1.2 Research process steps



C. RESULTS AND DISCUSSION

Implementation of Project-Based Differentiated Learning Model

The implementation of project-based differentiated learning models in natural and

social science learning aims to improve student learning outcomes according to students' interests and learning styles by providing the facilities needed by students in learning and a learning environment that can encourage student learning. This opinion is in line with (Bendriyanti, Dewi, & Nurhasanah, 2022). the implementation of differentiated learning models can provide quality student learning by meeting the needs of students according to their abilities.

Homogeneity test

A statistical test that aims to show two or more groups of data samples taken from populations that have the same variance. This study uses Levene's homogeneity test. This homogeneity test is carried out to check the data variables and a number of variances that are more than 0.05 it is considered uniform or homogeneous. Table 1.2 results of the data uniformity or homogeneity test.

Table 1.2 Test of Homogeneity of Variance

		Levene Statistic	df	df2	Sig.
Hasil Belajar Siswa	Based on Mean	3.042	1	34	.090
	Based on Median	1.417	1	34	.242
	Based on Median and with adjusted df	1.417	1	21.34	.247
	Based on trimmed mean	2.112	1	34	.155

Based on the results in table 1.2, it can be seen that the levene statistic is 3.042 with a significant value of 0.090. H0 is accepted, it can be concluded that the data variables and a

number of variances are uniform or homogeneous.

Normality test

A test that aims to assess the distribution of data in a group or variable, whether the data is normally or abnormally distributed. This study was conducted to determine the normal and abnormal data or variables with an amount of more than 0.05, it is declared normally distributed, if less than 0.05, it is not normally distributed.

Table 1.3 normality test of student learning outcomes of project-based differentiated learning model

TEST OF NORMALITY			
	Kolmogorov-Smirnov ^a Statistic	df	Sig.
Pretest	.237	18	.009
Posttest	.176	18	.144

a. Lilliefors Significance Correction

Based on table 1.3, the results of the data normality test show that the significant value of the pretest is $0.009 < 0.05$, it can be concluded that the pretest value is not normally distributed. The significant value of the posttest is $0.114 > 0.05$, it can be concluded that the posttest value is normally distributed.

Table 1.4 Two Related Samples

Pretest - posttest	
Z	-3.725 ^a
Asymp.Sig. (2-tailed)	.000

In the parametric normality test in table 1.3, there is data that is not normally distributed (pretest of $0.009 < 0.05$). So the researcher then used the wilcoxon two related

samples test to determine the difference in the results of the implementation of the Project-Based Differentiated Learning Model. The results of the two related samples test wilcoxon table 1.4 are sig. $0.000 < 0.05$, it can be concluded that there is a difference from the pretest and posttest scores in the implementation of the project-based differentiated learning model.

The difference from the analysis results in table 1.4, shows that the implementation of project-based differentiated learning models in natural and social science learning can improve student learning outcomes compared to direct natural and social science. Because the project-based differentiated learning model process groups students into groups, so that students are more confident in learning. Group learning in learning can help students to learn actively and be able to express their opinions. The project-based differentiated learning model process students are given a project that will be carried out in groups to improve student learning outcomes and experiences. In line with several opinions (Juliawan, Bawa, & Qondias, 2021). differentiated learning can foster the character of students' abilities and increase the effectiveness of students' learning to be confident (Pada et al., 2024). the differentiated learning model uses learning methods and media according to the learning styles and needs of students and can increase the learning creativity of students to create projects that are mastered by students in accordance with learning (Nadia Imti

Khaningrum¹, Sunarti², Daimul Hasanah³, 2023). Students who have learning creativity can help elaborate ideas and make learning easier (Mubaidilla & Ainiyah, 2022). Differentiated learning can respond to learners' learning progress in a sustainable manner, by creating a good and strategic learning atmosphere and student learning environment to find out what learners have learned and what learners are learning. Student learning outcomes can be influenced by the way teachers teach in differentiated learning (Sari & Arifin, 2022).

Figure 1.3 pretest



Figure 1.3, Before being given the implementation of a project-based differentiated learning model, students only listened to learning from natural and social science teachers on muscle force material.

Figure 1.4 posttest



Figure 1.4, Students are given the implementation of a project-based learning model, by providing projects according to their learning style. This project is to find out how much student learning outcomes and

provide student learning experiences to understand muscle force material.

Figure 1.5 student learning outcomes

	A	B	C	D	E
1	no	nama	pretest	posttest	
2	1	Ahmad Andy Arsyil	62	73	1
3	2	Aisyah nuha zahira	51	75	2
4	3	alisha khaira wilda	64	72	2
5	4	arlina salsabila	65	71	2
6	5	azzahra asila rahma	66	72	2
7	6	bianca trisha rara kirana	62	67	2
8	7	fariz naufal saputra	68	75	1
9	8	I made ray shabri rahmatullah	61	68	1
10	9	karimatul adzima	50	68	2
11	10	melani dwi anggryani sholicha	61	73	2
12	11	muh. Daffa ar-rayan	63	72	1
13	12	muhammad haikal ibrahim	58	67	1
14	13	muhammad teguh saputra	35	67	1
15	14	nelvia aurora adzana	62	76	2
16	15	pandya chena dhananjaya	59	63	1
17	16	syarif atta fairuz permana	66	69	1
18	17	muhammad bagus prayoga	56	73	1
19	18	muhammad saif hidayatulloh	64	75	1
20		rata-rata	59.61111	70.88889	

(1 = male 2 = female)

Figure 1.5, proves that the average pretest score is 59.6% of 18 students, and the average posttest score is 70.8% of 18 students. So it can be concluded that the posttest value is greater when compared to the pretest value, so it can be stated that the implementation of a project-based differentiated learning model can improve student learning outcomes and increase student learning experience.

Effectiveness of Project-Based Learning Model Implementation

The effectiveness of the project-based differentiated learning model in natural and social science learning aims to improve student learning outcomes and experiences by providing projects that are in accordance with student learning needs so that it is easy to understand natural and social science learning provided by the teacher (Nisak, Arifin, Fahyuni, & Rahmawati, 2021). This opinion is in line with (PERMADI, 2023), that product differentiation can show the final results of students' abilities, skills, and understanding in learning.

Table 1.5 Effectiveness Test

	N	Mean	Std. Deviation
Pretest	18	59.61	7.823
Posttest	18	70.89	3.612

Table 1.5 shows the mean and standard deviation of the posttest of the implementation of the project-based differentiated learning model. The average value of posttest learning outcomes is 70.89, with a deviation of 3.612. the average value of natural and social science applied by researchers is 59.61 with a standard deviation of 7.823. So it can be concluded that the implementation of the project-based differentiated learning model in natural and social science learning at MI Muhammadiyah 2 Kedungbanteng, Tanggulangin is effective.

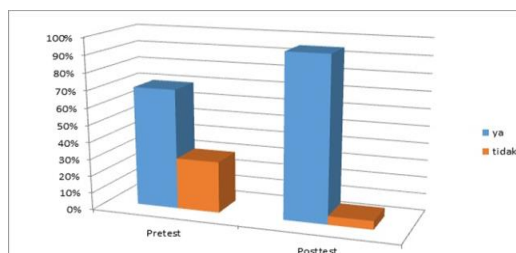
This shows the difference between the effectiveness of the project-based differentiated learning model and direct natural science. The average student learning outcomes are better than direct natural and social science. This is because the project-based differentiated learning model can help students in learning by providing projects that suit the needs of students in order to help students be more active and become serious individuals in learning. This is in line with the opinion of (Hadi & Ramadhana, 2022), The project-based learning process students can do in real terms, as if they can produce a realistic product. And in line with the opinion of (Sutrisno, Muhtar, & Herlambang, 2023), the differentiated learning model is learning

that is not done individually but is done together or in groups so that students know cooperation in learning and can provide input in accordance with learning objectives. Facilities in the learning model can be adjusted to the learning needs of students, so that learning can run optimally. Projects can be done by making simple learning media according to students' abilities (Media & Berbasis, 2023).

So the implementation of a project-based differentiated learning model can provide benefits for students in terms of, among others, increasing student knowledge and can improve student learning outcomes, helping students become good and responsible learners, increasing teacher satisfaction results in learning.

Observation instrument assessment

Figure 1.6 research observation



Based on the observations in Figure 1.6, the pretest conducted by researchers on the material understood by students in natural and social sciences, assessed based on the assessment indicators (Table 1.1), namely indicators known to be quite good and a percentage value of 70% of 18 students. Based on the observation results in Figure 1.6, the posttest conducted by researchers on the material understood by students in the

project-based learning model in natural and social science learning, assessed based on the assessment indicators (Table 1.1), namely indicators known to be very good and a percentage value of 95% of 18 students.

D. CONCLUSION

The implementation of the project-based Differentiated Learning Model in Natural and Social Science Learning has the aim of improving student learning outcomes according to students' interests and learning styles by providing the facilities needed by students in learning and a learning environment that can encourage student learning, so as a teacher must provide the facilities needed by students in learning. The effectiveness of the project-based differentiated learning model in natural and social science learning aims to improve student learning outcomes and experiences by providing projects that are in accordance with student learning needs so that it is easy to understand natural and social science learning provided by the teacher.

There is a significant difference in the implementation of project-based differentiated learning models and the effectiveness of the implementation of project-based learning models on direct natural and social science. This can be proven from the comparison of the average value of posttest learning outcomes of 70.89, and pretest of 59.61. It can be said that the implementation of project-based differentiated learning models and the

effectiveness of the implementation of project-based differentiated learning models are better than direct natural and social science.

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