

THE EFFECT OF *STEAM-BASED PJBL* MODEL AND ENVIRONMENTAL CARE ATTITUDES ON COGNITIVE RETENTION OF GRADE IV STUDENTS OF IPAS SDN RAGUNAN 08

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ABSTRACT

Research on project based learning includes Project Based Learning (PjBL), is a learning model that involves student in designing or creating projects that are innovative, useful in solving problems in daily life, and emphasizing contextual assessment learning. This study aims to find out whether or not there is an influence of the STEAM-based PjBL model and environmental care attitudes on students' cognitive retention in elementary school grade IV science learning. The learning model used in this study is an experimental method using a 2 x 2 factorial design design. The population of this study was 62 people, consisting of 31 students who learned using the STEAM-based PjBL model and 31 students who learned using the PjBL learning model. The research instrument was in the form of a questionnaire and multiple-choice test. The first hypothesis test using the Two-Path Anava Test was obtained with a sig value of $F_{\text{calculated}} > F_{\text{table}}$ or $19.94 > 4.105$, then H_0 was rejected and H_1 was accepted, meaning that there was an influence of the STEAM-based PjBL learning model on the cognitive retention of grade IV students of SDN Ragunan 08. The second hypothesis test using the Two-Path Anava Test obtained a value of Sig. Ftables, the value of $F_{\text{calculated}} > F_{\text{table}}$ or $33.49 > 4.105$, then H_0 was accepted and H_1 was rejected, meaning that there was no influence of environmental care on the cognitive retention ability of grade IV students of SDN Ragunan 08. The third hypothesis test using the Two-Path Anava Test obtained a value of Sig. $F_{\text{calculate}} < F_{\text{table}}$ or $3.64 < 4.105$, then H_0 rejected and H_1 accepted, meaning that there was no interaction between the STEAM-based PjBL learning model and the attitude of environmental care towards the cognitive retention ability of grade IV students at SDN Ragunan 08.

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1. INTRODUCTION

The 21st century known to bring change. In particular, rapid progress in science and technology (IPTEK) led to change curriculum, media, and technology so change the learning paradigm. The government has prepared life skills through education reform, which provides new developments and the best approaches to achieve these educational goals, to face the digital age

of twenty-first century. However, this study include previous research journals related to learning about the low quality of teachers in schools. The inability of students to develop scientific attitudes well in school presents another challenge in learning process. The scientific point of view in this case is earners usually have lower critical thinking capacity when trying to overcome learning-related difficulties. Lack of attention makes students not interpret every learning they through at school. This is certainly an obstacle for teacher in honing students skills (Bahri et al., 2019).

Another opinion in this journal says that use of the learning model PjBL This can also be linked to students' environmental care attitudes by maintaining environmental cleanliness and recycling goods to produce products based on STEAM (Rafsanzani et al., 2020). However, there are still many problems that occur in the field, including due to the lack of media, facilities and infrastructure in science development and the diverse understanding of educators in understanding science concepts (Amir & Purwanti, 2021). Another problem is the activeness and memory (retention) of students. When switching from distance learning to face-to-face learning, students activeness decreases further because students are still used to interacting online by only getting additional tasks, without meaningful activities in the learning process. Meanwhile, teachers themselves have not yet implemented learning models in their learning activities (Maharani et al., 2023).

Research on project-based learning includes Project Based Learning (PjBL), which is learning model that involves learners in designing or creating projects that are innovative, useful in solving problems in daily life, and emphasize contextual assessment learning. Project based learning has been proven to improve students scientific thinking skill (Afriana, 2022). According to research by Fitriyah & Ramadani (2021) publish in their publication, learning PjBL Based STEAM significantly improve students ability to think creatively, generate ideas, and store information. Cognitive learning outcomes tangible value in the consequence of mental (brain) activities that involve learning through one's own experiences. Retention of learners who last longer is another benefit the model PjBL, as owned by students so that the material obtained can be absorbed and attached to students' long-term memory (retention) (Bahri et al., 2019).

This is in line with the result of observations made in the previous research class on Tuesday, April 12, 2024, student memory of IPAS learning in Energy material (added to the achievements of previous learning results). Other than decline in the education report card of Ragunan State Elementary School 08 with an achievement of 6.39 from 2023 on the education report card sourced from the national assessment with a medium predicate, which means that learning is directed towards improving quality as indicated by a conducive classroom atmosphere and the presence of affective support and cognitive activation from the teacher but has not optimally carried out. In the world of education, not all educators are able to develop the potential of students even though they have been given a reference to the education implementation plan, This is because students' abilities to understand the material being taught vary, there are some students who are easy to understand the material and there are also those who find it difficult to understand the material.

With the development of increasingly modern era, it requires students to be more capable and have skills that must be developed. From the problems, a learning model need in which there is technology and can improve student attitudes of caring for the environment and cognitive retention. The learning model is the STEAM-based PjBL model. The STEAM method is one of the teaching strategies that is suitable to be used in conjunction with the PjBL (c) model. Learning

innovations that include the elements needed to build students' science process skills are project based learning (PjBL) integrated with STEAM (Science, Technology, Engineering, Art, Mathematics) (Suryanti et.al, 2019). According description, STEAM is an interdisciplinary learning that combines art and is useful for developing students' critical attitudes and creative thinking skills.

If science subjects are applied to real-world situations, learners will be more interested in learning them (Nuragnia et.al., 2021). Project Based Learning (PjBL) can be used to develop student creativity skill and science knowledge dimensions, so the student become more active, creative and have skills to produce quality and useful products. Model application PjBL Based STEAM a lot has been done, but research that measures environmental care attitudes is still rarely done, so this study we want to measure environmental care attitude. The attitude of caring for the environment in the educational institution is change in behavior shown by understanding, feelings and the tendency to apply their environmental knowledge through actions that have positive impact on the environment. Such as maintaining cleanliness and trying to prevent bad impacts that have potential damage the environment (Damayanti Fitri, 2020).

Model application PjBL Based STEAM A lot has been done, but research that measures environmental care attitudes is still rarely done, so this study we want to measure environmental care attitudes. Environmental care attitude in students is a change in behavior shown by understanding, feelings and tendencies to apply environmental knowledge through actions that have positive impact on the environment. Such as maintaining cleanliness and trying to prevent bad impacts that have potential damage the environment (Damayanti Fitri., 2020). This study, there is still a low caring attitude such as students who still throw garbage carelessly. When the learning process is still found inorganic waste scattered in the classroom and graffiti on chairs and classroom walls. This habit arises because there is still low attitude of caring for the environment from students (Arlina et.al., 2023).

To bring out student love for the environment, students must first get to know the interaction of living things with their environment so that new knowledge will emerge for students to protect environment (Qodriyanti et al., 2022). Model application PjBL based STEAM a lot has been done, but research that measures environmental care attitudes is still rarely done, so this study we want to measure environmental care attitudes. Environmentally caring attitude in the educational institution is a change in behavior shown by understanding, feelings and the tendency to apply their environmental knowledge through actions that have a positive impact on the environment. Such as maintaining cleanliness and trying to prevent bad impacts that have potential damage the environment (Fitri Damayanti, 2020). In this study, there is still a low caring attitude such as students who still throw garbage carelessly.

When the learning process is still found inorganic waste scattered in the classroom and there are graffiti on chairs and classroom walls. This habit arises because there is still a low attitude of environmental care from students (Arofah, 2021). To bring out student love for environment, student must first become familiar with environmental interactions things with their environment so that new knowledge will emerge for students protect the environment (Qodriyanti et al., 2022). Researchers interested in conducting model research PjBL Based STEAM and environmental care to improve cognitive retention (memory) in social studies learning in grade IV elementary school on energy materials in making simple waterwheels. This study was conducted with the aim of

testing the influence the model PjBL Based STEAM and environmental concern attitude towards student cognitive retention in social studies learning in grade IV of elementary school.

2. METHOD

This research is classified a experimental research type that uses a factorial experimental method with a quantitative approach. Experimental factorial is type of research design that has a randomly selected control group and experimental group. Quantitative data analysis techniques are used to analyze quantitative data, namely number-based data, both categorical data and numerical data. This method is validation, which is to test the influence of one or more variables on other variables. This data analysis technique is divided into two, namely data analysis with descriptive quantitative and data analysis with inferential quantitative. The research design used a 2x2 factorial design. This design is validation, which testing the influence of one or more variables on other variables. This study has three variables consisting of two independent variables and one bound variable (dependent variable). independent variables in this study are the STEAM-based Project Based Learning (PjBL) model and environmental care attitudes, as well as one bound variable, namely cognitive retention ability. The population this study is grade IV students at Ragunan 08 State Elementary School, South Jakarta, for the 2024-2025 school year, which totals 62 people. Consisting of 30 male students and 32 female students. The population is divided into two classes (rombel). The experimental group A in this study was a group of 31 students in class IVA who receive treatment using STEAM-based Project Based Learning (PjBL) learning, while experimental group B, namely a group of students in class IVB totaling 31 people who received treatment using Project Based Learning (PjBL). This, the sample used was 62 students as respondents.

3. RESULTS AND DISCUSSION

3.1 Analytical Prerequisite Testing I

1. Normality Test

Normality testing is carried out using the Liliefors test. The cognitive retention ability test in the experimental class, namely group A_{1B1}, obtained $L_{count} = 0.154$, at a significant level (α) = 5%, i.e. $L_{table} = 0.249$, while group A_{1B2} obtained $L_{count} = 0.176$, at a significant level (α) = 5%, i.e. $L_{table} = 0.258$. The cognitive retention ability test in the control class, namely group A_{2B1}, obtained $L_{count} = 0.141$, at a significant level (α) = 5%, i.e. $L_{table} = 0.258$, while group A_{2B2} obtained $L_{count} = 0.123$, at a significant level (α) = 5%, i.e. $L_{table} = 0.258$. Based on the results of data processing, the cognitive retention ability values of the four groups is smaller than the L_{table} , so it can concluded the data in this study are normally distributed in the Table 1.

Table 1. Normality Test Results Data

Group	N	Count	Table	Criterion	Information
A1B1	11	0,154	0,249	Calculate < L_{table}	Usual
A1B2	10	0,189	0,258	Calculate < L_{table}	Normal
A2B1	10	0,141	0,258	Calculate < L_{table}	Normal
A2B2	10	0,123	0,258	Calculate < L_{table}	Normal

Based on the Table 1 data on the 4 (four) variances that the value of $L_{calculating}$ critical thinking skills is smaller than the $L_{of\ the\ table}$, it can be concluded the data is normally distributed.

2. Homogeneity Test

This study conduct a homogeneity test using the Bartlett test. Based on results the homogeneity test from experimental class, namely groups A, 1B1 and A1B2 along with the control class, namely groups A2B1 and A2B2, the results of $X_{calculation} = 1.165$ were obtained, at a significant level (α) = 5% and db = 3, namely $X_{table} = 7.81$. The results of $X_{count} < X_{table}$, it can be concluded that the sample of the group is homogeneous and does not have different variants the Table 2.

Table 2. Homogeneity Test Results Data

Group	db	V	Xhitung	Xtabel	Criterion	Information
A1B1	10	82,77				Homogeneous
A1B2	9	97,33	1,165	7,81	$X2_{Calculate} < X2_{Table}$	Homogeneous
A2B1	9	63,46				Homogeneous
A2B2	9	127,91				Homogeneous

Based on the Table 2 data in the table above, it can be concluded that ther are 4 (four) data variances are homogeneously distributed because $X^2_{counts} < X2_{table}$ with a value of $1.165 < 7.81$.

3.2 Analytical Prerequisite Testing II

1. Normality Test

The normality test in this study conducted using Liliefors test. Based on critical thinking ability test data in the experimental class, namely the A1B1 group, it was obtained that $L_{count} = 0.116$ at a significant level (α) = 5% with $L_{table} = 0.234$. Meanwhile, the data of critical thinking ability test in control class, namely A1B2 group, was obtained $L_{count} = 0.189$ at a significant level (α) = 5% with $L_{table} = 0.300$. Meanwhile, the test data for critical thinking skills in control class, namely A2B1 group, was obtained $L_{count} = 0.245$ at a significant level (α) = 5% with $L_{table} = 0.258$. Meanwhile, the data of the critical thinking ability test in the control class, namely group A2B2, was obtained $L_{cal} = 0.115$ at a significant level (α) = 5% with $L_{table} = 0.300$ in the Table 3

Table 3. Normality Test Results Data

Group	N	Count	Tables	Criterion	Information
A1B1	13	0,116	0,234	Calculate < L _{table}	Normal
A1B2	7	0,189	0,300	Calculate < L _{table}	Normal
A2B1	10	0,245	0,258	Calculate < L _{table}	Normal
A2B2	7	0,115	0,300	Calculate < L _{table}	Normal

Based on the Table 3 data on the 4 (four) variants where calculated L_{hitung} for critical thinking skills is smaller than L_{table} , it can concluded that the data is normally distributed.

2. Homogeneity Test

The homogeneity test in this study carried out using Bartlett test with a significant level of 5% ($\alpha = 0.05$) to determine the variance of data from the 4 (four) groups studied. The results of homogeneity test for each class described as follows the Table 4:

Table 4. Homogeneity Test Results Data

Group	db	V	X ² _{count}	X ² _{table}	Criterion	Information
A1B1	13	120,859				Homogeneous
A1B2	7	194,143	0,612	7,815	$X^2_{count} < X^2_{table}$	Homogeneous
A2B1	10	169,067				Homogeneous
A2B2	7	234,286				Homogeneous

Based on the Table 4 data in table above, it can concluded the 4 (four) data variances are distributed homogeneously because $X^2_{count} < X^2_{table}$ with a value of $1.165 < 7.81$.

3. Hypothesis Submission

Analysis Results

This study, researchers used Microsoft Excel 2019 spreadsheet software to analyze the data (two-way ANOVA). The following test results are as follows the Table 5.

Table 5. Anava Analyst Results Data Two-Lane

S. Variant	JK	db	RJK	Calculation	F _{t(a)} = 0,05	Criterion	Information
Between A	1002,9	1	1002,9	5,97	4.139	F _h (A) > Table	H ₀ rejected, H ₁ Accepted
Between B	5612,16	1	5612,16	33,41	4.139	F _h (B) > Table	H ₀ rejected, H ₁ Accepted
AxB Interaction	-45,56	1	-45,56	-0,27	4.139	F _H (AB) < F _{table}	H ₀ accepted, H ₁ rejected
Deep Total	5542,48	33	167,95				
Total	12112,0	36					

Variant source	JK	Db	RJK	Calculation	F _{table}	Criterion	Information
Between Column A (<i>STEAM-based PjBL</i>)	1862,80	1	1861,80	19,94	4,105	Calculation > F _{table}	H0 rejected H1 accepted
Between Lines B (Attitude of caring for the environment)	3127,26	1	3127,26	33,49	4,105	Calculation > F _{table}	H0 rejected H1 accepted
AxB Interaction (<i>STEAM-based PjBL</i> and environmental care attitude)	339,46	1	339,46	3,64	4,105	Calculation < F _{table}	H0 accepted H1 rejected
Deep	3426,40	37	93,38				
Total	8783,41	40					

3.3. Discussion

3.3.1. The Influence of the STEAM-Based PjBL Model in Developing Cognitive Retention Skills

Based on hypothesis test, the results were obtained that met it, it can said that H₀ was rejected and H₁ was accepted, which means that is a significant influence of the use of the STEAM-based PjBL model on the cognitive retention ability of students in Energy material. In data from the research results, the average posttest score of the experimental class was higher that of the control class. This proves that use of the STEAM-based PjBL model in experimental class is better than the learning model with the PjBL model in the control class. This is in line with research conducted by Junaidi and Utama (2023), that learning by applying the STEAM based PjBL model can improve learning outcomes and student knowledge retention abilities. In addition, research conducted by Riyanto Agus (2020) regarding STEAM-based PjBL model learning can improve learning in 21st century. STEAM-PjBL not only inviting environmental awareness in students but also inspires to create, design and tech savvy, encouraging development of emotional, practical knowledge and cognitive (Pertiwi et al., 2024).

The application of the STEAM-based project-based learning model (PjBL) is innovative pedagogical approach that integrates principles from technology, science, engineering, art, and mathematics in project that is contextual and relevant to students. Context of developing cognitive retention skills, the model designed to go beyond rote learning and encourage deep understanding

and long-term memory through student active involvement in the process of inquiry, problem-solving, and creation. The main characteristic of application of STEAM-based PjBL model for cognitive retention is contextual and authentic project. Learning begins by identifying problems or challenges that are relevant to the student real-life or interests. The designed project encourages learners to apply knowledge and skills from various STEAM disciplines to produce real solutions or products. This powerful context helps learners understand the relevance of the subject matter and increases engagement, which turn strengthens information retention. Integrating STEAM disciplines, this model explicitly connects concepts and skills from different areas of STEAM.

For example, a project about building a model of a simple waterwheel props, this could involve the principles of science about renewable energy, technology in design and simulation, engineering in construction, art in design aesthetics, and mathematics in cost calculation and measurement. This integration helps learners see the connections between subjects and build a more holistic understanding, which facilitates long-term retention. Active learning is student-centered, in STEAM-based PjBL, students play active role in planning, implementing, & evaluating projects. They conduct research, collaborate, make decisions, and solve problems independently. This active engagement encourages deeper and more meaningful information processing, in contrast to passive learning which tends to result in lower retention. The learning stages in integrated PjBL model of the STEAM approach consist of six stages, including: determining fundamental questions (Science as a process), preparing project planning (Technology the application of science), preparing schedule (Engineering as engineering), monitoring students and project progress (Arts as an art), assessing results (Mathematics as a tool) and experiential evaluation.

According to Mercy and Tuappatinaya (2023), the syntax of PjBL makes it possible to increase students to learn and think actively. These results corroborate the results of previous research (Triyatma., 2017) the application of STEAM-based PjBL learning can improve student cognitive retention skill. The STEAM-based Project Based Learning (PjBL) learning model has proven to have positive influence on student cognitive retention. This approach not only focus on the delivery of material, but also integrates cross-disciplinary concepts involving real and creative activities. Cognitive retention obtained based on student posttest scores in answering multiple-choice questions on Energy material with indicators of making simple waterwheel props. The posttest data that has been obtained is a prerequisite test for the sample. Prerequisite exam through two tests, namely normality test and the homogeneity test. The normality test based on data obtained showed that the posttest results in control class and distributed experimental class were normal.

Similarly, the homogeneity test shows that two classes are homogeneous, so it can concluded that two classes normally distributed and homogeneous. Effectiveness of STEAM-based PjBL model on cognitive retention ability was known by hypothesis testing with independent sample t-test. Hypothesis tests were carried out on posttest data in the control class and also experimental class. Based on results of the hypothesis test, it shows both classes have the same initial ability. There is compatibility between results of the hypothesis test which proves that the two classes have the same ability. In line with the research of Nirmayani and Dewi (2021), The results of the analysis of the pre-test data hypothesis test showed that there was no difference in the initial abilities of students in the control class and the experimental class, so it worth comparing. Next test is posttest hypothesis test. The results of posttest data with the independent

sample t-test showed that was a significant difference in the control class and experimental class. This means that STEAM-based PjBL model is effective in increasing student cognitive retention in Energy materials. In accordance with the research conducted by Fitriyah & Ramadani (2021, pp. 217–218).

Based on posttest hypothesis test in their research, there is an average difference cognitive retention of students between control class (PjBL model) and experimental class (STEAM-based PjB). Next study that obtained the same results was from researchers Pramesti, Probosari, & Indriyanti (2022, p. 447), that is a difference between STEAM-based and PjBL-based PjBL classes. The effectiveness of the STEAM-based PjBL model is also supported by the average results of posttest scores that have been done by students. Based on average results, it was seen that experimental class was superior in cognitive retention ability by implementing STEAM-based PjBL model compared to control class by implementing PjBL model. Students who are used to learning using project-based learning are also indirectly trained in the cognitive retention skills. According to constructivism theory that underlies the Project Based Learning (PjBL) model, knowledge is actively built by learners through real experiences and social interaction (Thuneberg et.al, 2018).

In this study, students in experimental class were involved in projects relevant to daily life, so that they could relate theoretical concepts to practical applications. STEM-PjBL is educational model that combines Technology, Science, Engineering, and Mathematics with project-oriented tasks (Alkautsar et al., 2023). STEM-PjBL is characterized by Engineering Design Process (EDP), implementation EDP involves a cycle begins with define the problems, studying scientific concepts, planning solutions, trying out solutions that have been created, and create decisions with the PjBL-STEM syntax including (1) reflection, (2) research, (3) discovery, (4) application, and (5) communication (Laboy Rush, 2011). In conclusion, the application of the STEAM-based PjBL model has been proven to have positive impact or influence on student cognitive retention. Through a project-based approach, learners acquire the good cognitive retention skills necessary to deal with real-world challenges. Therefore, STEAM-based PjBL can be alternative learning strategy that is relevant to improve quality of education in elementary schools.

3.3.2. The Effect of Environmental Care on Student Cognitive Retention Ability

Attitude of caring for environment not only provides moral values and social benefits, but also plays important role in supporting student cognitive retention. In project-based learning, students are faced with problems or challenges must be solved. Attitude of caring for environment a support in classroom learning that is effective in helping students understand learning in making right decisions. The value of caring for environment has developed after implementation of environmentally friendly waste recycling program. This is due to implementation of recycling program, namely by making a simple waterwheel model, students are given an understanding of importance maintaining the balance of nature. One of them is by recycling waste. Waste that is synonymous with dirty is transformed into something that can processed into something interesting and useful. The ability of students to care for environment can improved so that they are aware and more proactive in protecting environment. Environmental awareness is individual's ability to recognize and analyze environmental conditions effectively (Cole, 2019).

Learning models that provides opportunities for student participation is Project Based Learning (PjBL). This indicates students with better attitudes of caring for the environment tend to have higher cognitive retention abilities compared to students with low cognitive retention. The attitude caring for the environment gives students ability to condition school environment to habituate behavior of caring for environment of students and other school residents. Based on hypothesis testing, the results were obtained that met it, can be said that H_0 was rejected and H_1 was accepted, which means there is a influence of student environmental concern attitudes on cognitive retention abilities of grade IV students in elementary school in the science subject of Energy material. The results of study show the attitude of caring for environment has significant influence on the cognitive retention ability of students. This is relevant to environmental stewardship, defined as attitudes and actions that seek to prevent damage to the natural environment and develop efforts to repair damage that has already occurred.

It can said that environmental stewardship is attitude possessed by someone who strives to improve and properly manage environment so that it can be enjoyed sustainably without damaging it, and to maintain and preserve it so that it provides ongoing benefits. (Puspasari and Puspita., 2022). Environmental care is an exemplary attitude that has goal of realizing harmony, harmony, and balance between humans and environment, creating environmental people who have attitudes and actions to protect and foster the environment, realize the wise use of natural resources, and the protection of the Unitary State of the Republic of Indonesia against the impact of businesses and/or activities outside the country's territory that cause pollution and/or destruction environment (Sari et.al., 2021). Environmental stewardship is character trait that must instilled in schools at every level of education. All school members are required to demonstrate environmental stewardship by improving environmental quality, raising awareness of the importance of environmental stewardship, and taking initiative to prevent environmental damage.

Environmental stewardship is instilled in students from an early age so they can wisely manage their natural resources and foster a sense of responsibility for the well-being of future generations. Once a strong sense of environmental stewardship develops, it will inform their daily behavior. (Anggraini and Wulandari., 2020). Caring for and preserving the environment is attitude that every child of the nation must have. Caring for the environment means paying great attention and taking great action to preserve the environment and repair it when damage occurs. Instilling attitude of caring for environment can be instilled in students by making students habituous of washing their hands during break hours, as well as washing their hands before and after meals. All students are also accustomed to throwing garbage in the place that has been provided. The cultivation of this character can become a habit if it is habituated in every line of life. If every human being has this character, then the balance of nature with the environment of human living things, animals and plants, and other inanimate objects will run well. This habituation is expected to be able to change our character into human beings who respect the environment.

In this study, there was a difference in mean values both in experimental class and control class to measure cognitive retention ability with 2 (two) categorizations of environmentally caring attitude, namely low category environmental care attitudes and high category environmental care attitudes. In experimental class, the researcher applied the STEAM-based PjBL model and control class, the researcher applied PjBL model. The average score (mean) in the control class with a low category of environmental care. This means that when teaching and learning activities apply the STEAM-based PjBL model or the PjBL model , but students in the classroom have attitude of

caring for environment with high category, it will affect the cognitive retention ability of students, while when teaching and learning activities apply the STEAM-based PjBL model or the PjBL model. However, students in the classroom have attitude of caring for environment with low category, the effect on cognitive retention ability is not significant.

In conclusion, Environmental care attitudes have been shown to have a significant influence on cognitive retention abilities of classroom students. With the increase in environmental care, students can more responsible for the environment. They will understand the importance of maintaining cleanliness and also environmental sustainability as part of personal and social responsibility. As well as playing an active role in environmental conservation activities such as reforestation, recycling, or cleanliness campaigns in schools and communities.

3.3.3. The Interaction Between the STEAM-Based PjBL Model and Environmental Care Attitudes Supports Students' Cognitive Retention Abilities

The results of study show the interaction between STEAM-based PjBL model and environmental care attitudes on students' cognitive retention abilities is not significant. Based on the Two Way ANOVA test, it was shown that there was no interaction relationship between the STEAM-based PjBL learning model and environmental care attitudes in affecting students' cognitive retention abilities. This can be proven when the application of the STEAM-based PjBL model and the application of the PjBL model to students who have a high category of environmental care do not all have high cognitive retention capabilities. There are students who have a low level of environmental awareness. Likewise, in application of PjBL model to students who have a low level of environmental awareness, not all of them have low cognitive retention ability, some have high cognitive retention skills. In other words, the influence of environmental concern attitudes on students' cognitive retention abilities does not depend on the type of learning model used, both in the STEAM-based PjBL model and by using the PjBL model.

One learning model that provides opportunities for student participation is Project Based Learning (PjBL). The PjBL model guides students in discussions and collaboration to study and understand environmental issues and address them by formulating solutions (Indranuddin et al., 2024). The results of this study indicate that students' environmental awareness abilities are not significantly influenced by interactions between STEAM-based PjBL model and environmental care attitudes. Thus, the two approaches can work independently with significant interactions. In this study, students in experimental group gained project based learning experience through STEAM-based PjBL, while attitude of caring for environment provided students with many benefits, both in terms of personal, social, and academic development. Some of the benefits are environmental awareness, Students become more aware of the importance of protecting the environment and the impact their actions have on it. Building positive character and caring for the environment helps foster responsibility, discipline, and empathy for other living things.

Improvement of life skills, through activities such as recycling, greening, or waste management, learners learn practical skills that are useful in daily life. The balance of the local ecosystem, the active participation of students in protecting the environment, such as planting trees or cleaning up garbage, helps to create a healthy and comfortable environment for everyone. Creativity and innovation, students are often invited to create innovative solutions, such as making products from used goods, so as to train their creativity. Social awareness, this attitude also teaches

them to think more broadly, understanding the importance of working together to address global environmental problems. However, the results of the study show that these two approaches significantly reinforce each other in improving students' cognitive retention skills. This is because each approach has contributed separately to the development of students' cognitive retention.

By integrating STEAM and project-based learning, Students can learn by completing more than one project that is relevant to everyday life (Guo&Tang, 2021). Research conducted by Nuriani&Muliawan (2020) showed results that 95% of students are more interested in learning science, if the material relates to everyday or real-life problems. Project-based learning can be used to develop science process skills, enabling students to more active, creative and equipped with the skills to create useful and high-quality products (Nasir et al., 2019). In science learning, students not only learn how understand a concept, but also how students can master science process skills and apply them in a project. Students can become more aware of the material being taught, because students can play active role in learning, so that indicators of student science process skills can achieved (Setiawan et al., 2021). A lot of research on STEAM has been conducted, but learning that integrates STEAM projects utilizing social media very limited, so research is needed.

In addition, the researcher feels that it is necessary to know the science process skills and creative thinking skills in completing the STEAM Project learning in the learning of chemistry, acid-base titration materials reviewed from several indicators, science process skills, and creative thinking skills. As described above, this study aims to determine the cognitive retention ability of science and creative thinking skills of students in learning Science Energy material in the manufacture of simple watermill model teaching aids using the integration of the STEAM project. In conclusion, although the STEAM-based PjBL model and environmental care attitudes each have a positive impact on students' cognitive retention abilities, the interaction between the two has a significant influence in this study. This suggests that both approaches can function simultaneously in improving learners' cognitive retention.

4. CONCLUSION

Application of learning model that is accordance with its essence will have a positive impact on cognitive retention ability. However, it is quite unfortunate if application of learning model only applies conventional model because it can be less effective in developing cognitive retention skills or environmental care attitudes of students. Based on results of calculations that have carried out on hypothesis I, H_0 is rejected and H_1 is accepted, which means there is influence on the use of STEAM-based PjBL learning model on cognitive retention ability of grade IV students at SDN Ragunan 08. Based on results of calculations that have carried out hypothesis II, the comparison between the obtained F_{value} and the F_{table} . Thus, there is an influence of environmental care attitudes on the cognitive retention ability of grade IV students at SDN Ragunan 08, which means that H_0 is rejected and H_1 is accepted. Based on the results of the calculations that have been carried out on hypothesis III, the comparison between the F_{value} obtained with the F_{table} , the $F_{\text{value}} < F_{\text{table}}$. Thus, it can be concluded that H_0 was accepted and H_1 was rejected, which means that there is no interaction between the STEAM-based PjBL learning model and environmental care attitudes towards the cognitive retention ability of grade IV students at SDN Ragunan 08.

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