

The Influence of Project Based Learning Model in Training Students' Argumentation Skills

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Received: March 12, 2024

Revised: August 21, 2024

Accepted: October 25, 2024

Published: October 31, 2024

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DOI: [10.29303/jppipa.v10i10.5062](https://doi.org/10.29303/jppipa.v10i10.5062)

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Abstract: The preliminary study data shows that the argumentation ability in SMA 8 Kota Cirebon is relatively low, this shows that the argumentation ability of students has not been stimulated properly. The Project Based Learning model is here to train students' argumentation ability. Using an experimental method with Quasi Experimental Design. The sample of this study was the control and experimental classes. The assessment technique was in the form of observation sheets and t-tests. The results of the study showed that the project based learning model can train argumentation ability through its syntax, t-test and n-gain test there were significant values with t-test results of $0.05 < 0.01$ while in the n-gain test with a result of 67.25% with a fairly effective category, so that argumentation ability is at level 3. The conclusion that can be drawn from the application of this project based learning model can train argumentation ability.

Keywords: Argumentation skills; Project based learning

Introduction

The development of education in Indonesia in the 21st century is marked by rapid technological developments, making science and technology one of the most important foundations of national development. The increasingly rapid and sophisticated technological advances, in 21st century learning, require the role of teachers with character in order to keep up with the times. Responding to changes in learning patterns in the era of globalization, schools are expected to provide stimulus for students to be able to practice 21st century life skills known as 4C, consisting of: (a) creative thinking, (b) critical thinking and problem solving, (c) communication and (d) collaboration (Septikasari et al., 2018). The application of learning based on 4C skills is expected to improve thinking skills. In order to face the challenges of the 21st century, students must have the ability to represent and argumentation skills (Denny DPJ et al., 2023). Argumentation skills can be formed when students are

able to analyze, evaluate and create a concept (Alberida et al., 2022). Improving the quality of arguments needs to be supported by supporting elements to produce more consistent arguments during argumentation. Supporting elements must be able to present accurate information that affects the quality of arguments that explore the scientific concepts discussed (Demircioglu et al., 2023). An in-depth understanding of science in discussing a problem is very necessary in framing argumentation skills, because qualitative analysis must be in accordance with quantitative data, so that a way out of prolonged discussions is found (Giri et al., 2020). Decision-making skills about the strength and validity of evidence, scientific thinking, and reasoning are needed in the scientific compilation process.

Saraswati (2020) revealed that the most important basis for training argumentation skills is critical thinking, reasoning and logic, besides that argumentation practices in learning have an influence on increasing knowledge and understanding (Hani'ah et al., 2022).

How to Cite:

Nurdiyanti, D., Azizah, D., & Fatimatuzzahra, A. (2024). The Influence of Project Based Learning Model in Training Students' Argumentation Skills. *Jurnal Penelitian Pendidikan IPA*, 10(10), 7527-7533. <https://doi.org/10.29303/jppipa.v10i10.5062>

The argumentation process can be analyzed using Toulmin's argumentation. The Toulmin Model of Argumentation (TAP) is a model developed by Stephen Toulmin (2003) which contains the structure of the argumentation framework. This model contains a guide to building critical and persuasive arguments. By applying the TAP model, the arguments given are more reliable, credible, less susceptible to rebuttal, and generally more efficient and effective. This model is the right choice because this model is adapted to everyday argumentation and has the basic nature of discourse.

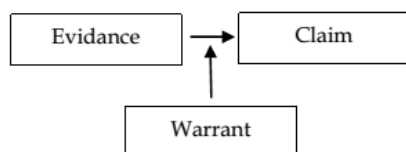


Figure 1. The Toulmin of simple argumentation

The argumentation ability assessment rubric includes the following:

Table 1. Argumentation Competency Level Rubric

Competency levels	Scientific Argumentation Ability Indicators
Level 1	An argument contains one claim against another claim.
Level 2	Argumentation has arguments from one claim against another claim with data, warrants and supporters, but does not contain rebuttals.
Level 3	Argumentation has arguments with a series of claims, data, warrants and supporters and weak rebuttals.
Level 4	Argumentation shows arguments with clear rebuttals and contains several claims.
Level 5	Argumentation presents an extended argument with more than one clear rebuttal.

In addition to the argumentation assessment rubric, there is also a Toulmin argumentation structure consisting of six components, namely statements (claims), data (evidence), justification (warrant), support (backing/support), qualifications (qualifiers), and rebuttals. Of the six aspects, according to Toulmin, the most important aspects of an argument are three aspects, namely: claim, evidence, warrant.

Facts in the field when conducting a test on the argumentation skills of chemistry subjects on acid-base material in the even semester of the 2021-2022 academic year showed that students' argumentation skills were still at level 1. This fact identifies that students have not been trained to argue. Argumentation skills can be trained through scientific speaking and writing activities

which are obtained by exploring and deepening scientific literacy (Gültepe et al., 2021).

Chemistry is part of science. Chemistry is a discipline that trains students' thinking skills through three levels of representation, namely macroscopic, submicroscopic, and symbolic (Sudiatmika et al., 2016). Increasing the level of representation of chemistry in students will have an impact on improving their thinking skills. Such as using chemistry teaching materials which of course must contain phenomena from the substance being studied (Nurdiyanti et al., 2020b).

Practicing argumentation skills in learning chemistry can be done through experimental activities. Experiments are carried out through group activities by identifying questions and following up on them, writing, observing, asking questions and conducting experiments. Then students share results, compare claims and evidence through argumentation and negotiate questions in small or large groups (Kabataş Memiş et al., 2020). Through experimental activities, students are able to produce products through a series of projects that will train argumentation skills in providing evaluations and claims of products that have been made when presented. Based on basic competencies 3.10 and 4.10 in acid-base material, this material is classified as a macroscopic, microscopic and symbolic representation level. Macroscopically, the use of litmus paper in determining the acid-base of a solution can be seen directly by the eye, while microscopically the chemical phenomenon of the color change occurs but cannot be seen with the naked eye. Especially for symbolic classification, acid-base material is in the form of symbols, namely the symbols H^+ , pOH , OH^- , K_a and K_b (Andriani et al., 2019). According to Azizah et al. (2022) stated that one must have more skills in teaching chemistry because in learning students are able to reason through phenomena that exist in everyday life, using the surrounding environment as part of the learning material.

Seeing the characteristics of acid-base material, to train students' argumentation through critical and creative thinking can be done with a dishwashing soap making practicum, with the practicum students will be able to argue by developing their reasoning skills why they choose materials, tools, processes and how to package the product and also the results of the product.

As an effort to train project-based argumentation to produce dishwashing soap, a learning model is needed that is able to carry out learning by doing activities. One learning model that can use projects to produce innovative products is the Project Based Learning learning model (Parmani et al., 2019).

The Project Based Learning model is a learning model that is able to demonstrate students' cognitive

abilities (Wang et al., 2023), improve students' thinking skills (Yanti et al., 2023), is able to improve 21st century skills known as 4C skills (Azmi et al., 2023), besides that PjBL also facilitates students to use thinking skills in producing a useful product or work (Radiansyah et al., 2022). In this learning model, students are trained to think logically and creatively to find out their abilities. According to Dias et al. (2017), Project-Based Learning (PBL) provides students with the opportunity to build and continue deeper qualities in academic content and understand how to apply them in the real world. Then students are asked to present the results of the products that have been made and explain all their designs.

The project based learning model is very suitable for use in current learning, in addition, the project-based learning (PjBL) learning process has been proven to develop critical and creative thinking of students by producing products that are able to train students' reasoning and logical thinking skills, thus students are expected to be able to provide good arguments for the products they make.

Based on the description of the problems that have been described previously, to solve the problem of low argumentation skills in one of the high schools in Cirebon, the researcher raised a research topic by taking the title "The Effect of the Project Based Learning Model in Training Students' Argumentation Skills"

Method

The method used in this study is the experimental method. The research design used is the Pretest-posttest Non-Equivalent Control Group Design found in the Quasi Experimental Design. There are two study groups, the experimental group and the control group. The experimental group received special treatment in learning with the Project Based Learning (PjBL) learning model, while the control group did not (using conventional methods) (Farihatun et al., 2019). This research design can be seen in table 2.

Table 2. Pretest-Posttest Non-Equivalent Control Group Design (Sugiyono, 2018)

Group	Pretest	Treatment	Posttest
experiment	O ₁	X ₁	O ₂
control	O ₃	X ₂	O ₄

Information:

- O₁ = pretest experimental class
- O₂ = posttest experimental class
- O₃ = pretest control class
- O₄ = posttest control class

The research instruments used consist of 2 instruments. The test instrument is used to measure

students' argumentation skills consisting of 10 essays. The test data obtained will be tested statistically with prerequisite tests, hypothesis tests (t-tests), n-gain tests and learning implementation observation sheet instruments.

Result and Discussion

Project-based learning is a learning model that emphasizes the use of an activity or project as a learning support. Students are expected to be able to research, evaluate, interpret, synthesize, and synthesize information to achieve various learning outcomes. Project-based learning has the characteristics of training students to make decisions based on a framework, deal with problems or challenges, plan a process to find solutions to the problems or challenges presented, be jointly responsible for collecting and managing information to solve problems, the assessment process is carried out continuously, reflect periodically on the activities carried out, the final learning outcomes are assessed quantitatively; and the learning situation is very tolerant of errors and changes (Al-Awab et al., 2021).

Students' argumentation ability can be seen from the results of the pretest and posttest in the form of argumentation ability test questions that have been tested valid and reliable. Data from the pretest and posttest results of the experimental class and control class.

In this study, researchers obtained data from the results of the pre-test and post-test that had been carried out. The pre-test is an ability test given to students before being given treatment, while the post-test is carried out after students receive treatment. Both of these tests function to measure the effectiveness of the learning program. Before collecting data, researchers conducted a trial of the question instruments that would be used as pre-test and post-test questions. The results of the data analysis obtained from the test sheet containing 10 questions that had gone through the instrument trial by obtaining the average results of the pre-test and post-test as follows:

Table 3. Pretest and Posttest Results

	Experimental class		Control class	
	Pretest	Posstest	Pretest	Posstest
Minimum value	35.2	70.0	25.5	67.5
Maximum value	55.5	95.5	47.5	95.5
Average	43.5	83.2	36.5	79.8

Based on the pretest value obtained with the average value before and after treatment, it has a value that has a significant influence on argumentation skills. Then after the trial is carried out and the results are

known, it is continued by taking initial data using a pre-test in the experimental class and the control class. Then given treatment, where the experimental class uses the project based learning model. According to Sari et al. (2020) this PjBL learning can facilitate students to do individual assignments well or work in groups, as in project-based learning. This project-based can measure students' ability to create conceptual work, both individually and in groups, so it is better to use a learning model that creates contextual work, using this learning students can create real work, which is supported by the project-based learning model. While in the control class with the discovery learning model. According to Elvira et al. (2016) teachers can use learning models to help students develop argumentation skills. One of them is by implementing the discovery learning model. So in this study the researcher used both models to find out students' argumentation skills. Then after the two classes were given treatment, a post-test was given to the two classes. So the results of the pre-test and post-test based on the calculation results using SPSS 25, the pre-test and post-test values have quite significant changes. This means that the ability to train students' arguments can be increased after treatment with the criteria of argumentation.

In addition to the results of the pre-test and post-test, researchers also use the results of the T test and the implementation sheet of the learning model. Before the T test results, we first know the results of the argumentation from the pre-test and post-test results as in Figure 2.

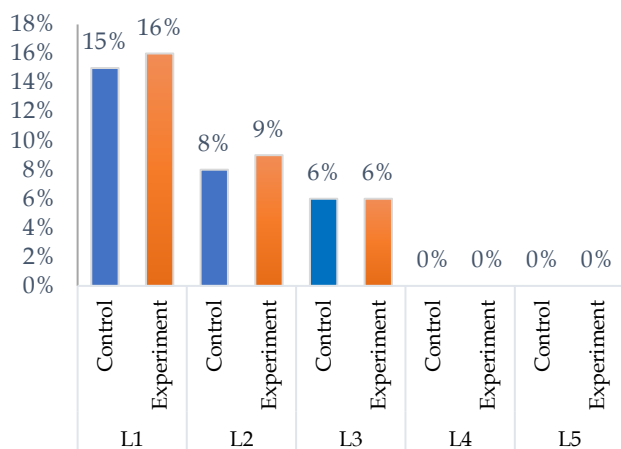


Figure 2. Control argumentation ability

Based on the results obtained, the results of argumentation ability in class XI Mipa 1 and XI mipa obtained quite significant results from the pretest and posttest values. The results of the graph are the percentage of students' argumentation levels in the experimental class level 1 (16%), at level 2 (9%), at level

3 (6%) while at levels 4 and 5 (0%), while in the control classes level 1 (15%), at level 2 (8%), at level 3 (6%) while at levels 4 and 5 (0%), from both classes at level 4, and level 5 have not been achieved because students give incorrect claim answers, but there are also students who do not fill in their answers. The results of the study showed that the average level of students' argumentation was still low, only up to level 3.

Hypothesis Test (t-Test)

After the data of the two samples for the experimental class and the control class obtained from the study were then tested with the normality test and the homogeneity test. The test results prove that the samples are normally distributed and have homogeneous variance. Then the data can be used for hypothesis testing. Hypothesis testing is carried out to see if there is a significant difference before being treated and after being treated with the Project Based Learning Model. This hypothesis test is carried out using the t-test at a significant level ($\alpha = 0.05$) with the testing criteria if the t-test is significant <0.05 .

N-Gain Test

The N-Gain test is obtained from the difference between the pretest and posttest carried out by students with the aim of determining the increase in argumentation skills after learning in the experimental class and the control class. The results of the N-gain score test obtained were 0.67 with a high category and the n-gain percentage was 67.25% with a fairly effective category.

Implementation of PjBL

In the implementation of this learning model, observation sheets are used as a reference to determine learning activities by referring to its syntax. In this study, researchers trained students' argumentation skills by using the Project Based Learning learning model. Based on the class KKM data, the average value was 77, the KKM data showed that the average class ability was above the KKM value, thus the average class ability was classified as students who were able to follow the learning well, this was in contrast to the initial data that researchers obtained when conducting observations regarding students' argumentation skills which showed low argumentation skills. According to Umar (2017) the Project Based Learning Model or abbreviated as MPBP is a learning model that involves students directly in the learning process through research activities to complete a project or problem. One of the advantages of project-based learning is that this learning model is one of the best learning models for developing students' thinking skills, decision-making skills, acting skills and different problem-solving skills, which can increase self-

confidence at the same time in students. So that it can maximize the teaching and learning process.

According to Du et al. (2016), the steps in the learning model are pre-project, project planning, project implementation schedule, monitoring, compiling reports, evaluation and after the project. In the pre-project activity, researchers stimulate students to plan a project in learning, which begins with basic questions, to students by informing them of the negative impacts of using soap using excessive chemicals and can cause the formation of cancer cells. So that students are given stimulus on how to overcome the negative impacts of soap, namely through the use of natural ingredients that we usually find in everyday life. Based on these questions, students are stimulated to make products that are the right steps to solve the problem of dishwashing soap products containing chemicals that cause skin irritation and formaldehyde content that can trigger the formation of free radicals.

According to Sahlan (2023), the use of formalin as a preservative in dishwashing soap has carcinogenic properties. The formalin will be washed away when rinsed and there are still ingredients left behind. The ingredients left on the washed dishes are what will cause the formation of cancer cells.

According to Sri et al. (2017), good soap not only cleanses the skin from dirt, but also contains substances that are not harmful to the skin and can protect it from the effects of free radicals. The effects of free radicals on the skin are characterized by the appearance of wrinkles that cause the skin to age quickly, the appearance of dark spots, look duller and drier and can even cause skin cancer.

Making soap is expected to train students' argumentation skills that can collect information in the form of accurate data so that when explaining, students can answer according to the data that has been obtained. Like research from Nurdianti et al. (2020a) states that the next basic element of argument is data. When collecting data that has been obtained or studied, students will ask the teacher so that their argumentation skills will emerge by answering questions according to the data they obtain. According to Muslim (2015), through argumentation activities, students are involved in providing valid evidence, data, and theories that support opinions (claims) about the problems being implemented. So that the data that has been obtained can be proven properly.

After conducting a pre-project, students carry out project planning for making a project where students formulate a schedule, this is where the argumentation ability lies where each student will formulate a project with their group and will argue with each other by collecting data first so that in the implementation of soap making can be carried out with the data that has been

obtained previously. According to Baharsyah et al. (2020), the discussion process in this case can train students' scientific reasoning skills through discussion, because discussion can improve students' abilities in argumentation.

After the schedule is formed, the next step is monitoring or implementing the making of dishwashing soap in the classroom. After determining the schedule and dividing into 6 groups, each student gathers with their group by bringing the tools and materials that have been determined. Furthermore, students are asked to make soap by taking plant extracts from each group and then storing them in a container. After the extract is taken, each group leader takes chemicals to mix dishwashing soap. Teachers and students discuss the uses of these materials so that many questions arise that will hone students' ability to argue. According to Baharsyah et al. (2020) through reasoning activities, students will be involved in providing evidence, information, and valid theories that support opinions (claims) about the problem. Therefore, this step in monitoring can create student arguments.

Preparation of reports where in this preparation students are asked to write all the series that have been carried out during the dishwashing soap making practicum. According to Hariawan et al. (2022) a production process is said to be good if the process produces products that meet the specified standards. The narrative expressed by students regarding product quality will show the extent of their argumentation ability. According to Toulmin (2003) there are 3 stages of indicators in arguing.

After the report preparation stage, students are then directed to evaluate. Evaluation is carried out through presentations from each group about dishwashing soap products. Through this activity, students are expected to assess each other regarding product quality, so that students can create quality products, with maximum results, the teacher provides input regarding the quality of dishwashing soap products. In addition to the evaluation stage in the Pjbl step, there is a next stage, namely the post-project stage, at this stage students are expected to reflect after the activities that have been carried out by expressing feelings and experiences during the implementation of the practicum. Reflection activities can increase students' insight to express their opinions by stating their respective opinions regarding the dishwashing soap making activities that they have done. According to Arrazi et al. (2021) stated that making dishwashing soap with good procedures and the right information will produce quality dishwashing soap.

Conclusion

Based on the hypothesis, objectives, and results of the research that has been conducted, it can be concluded that the argumentation ability of students at SMA 8 Kota Cirebon in class XI MIPA 1 and XI MIPA 4, the argumentation ability which is classified as low is trained by using the project based learning model. The use of the project based learning model in training students' argumentation ability can be exceeded to level 3.

Authors Contributions

The first researcher contributed to the implementation of the research, analysis and writing of the initial article, the second researcher as data collection personnel, data analysis and writing of the initial article, the third researcher contributed to controlling the research, reviewing the initial article and revising the article.

Funding

This research was funded by LPPM Muhammadiyah University of Cirebon.

Conflicts of Interest

All authors declare that this article has no conflict of interest.

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