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The Effect of Using Inquiry Model on Science Process Skills and Student Learning Outcomes

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Abstract: Science learning must be changed by applying real and active science process skills which are shown by students being able to understand the use of tools, methods, and procedures and apply them in the discovery process and communicate them based on the evidence they get. The purpose of this study was to see the impact of the use of the inquiry model on science process skills and student learning outcomes. The research method used is a combination of quantitative and qualitative methods designed using a pre-test-post-test control group. The samples of this research were 7th-grade junior high school students. The length of the research process is 12 weeks. The results showed that there were significant differences between the two groups. This indicates that the inquiry model has a positive impact on students' science process skills. This was also accompanied by positive results on student learning outcomes in the group using the inquiry model. The conclusion is that quantitatively the fact that the inquiry learning model can improve science process skills and student learning outcomes is found. Optimizing the application of this model is needed to support progress in the education quality.

Keywords: Inquiry; Learning outcomes; Science process skills

Introduction

The phenomenon of learning theory, exercises and exams are common activities in the learning process. Often the final exam score is the most important thing which sometimes actually ignores the process and stages that are passed during the learning activities. In fact, the success of the teaching and learning process is not only determined by the final results of learning, but is also determined by the actions and interactions between teachers and students during learning activities (Fahmi & Irhasyuarna, 2019).

Science learning emphasizes science process skills that develop directly through the experiences students gain as learning experiences. In the learning process, this skill emphasizes what activities occur during the learning process with learning outcomes as one of the impacts of these activities (Sugiarti & Ratnaningdyah, 2020; Ahmed et al., 2023). Science process skills are very important in teaching because they can make learning more efficient (Shahali & Halim, 2010).

As an indicator of success in learning, research on science process skills has been carried out for a long time and continues to develop continuously. Research on this matter was carried out by many people and in many different places and educational backgrounds (Bati et al., 2010; Aydinli et al., 2011; Delen & Kesercioğlu, 2012; Mutlu & Temiz, 2013; Osman & Vebrianto, 2013; Abungu et al., 2014; Aydogdu, 2015; Arabacioglu & Unver, 2016; Artayasa et al., 2017; Idiege et al., 2017; Prayitno et al., 2017; Irwanto & Prodjosantoso, 2018; Jack, 2018; Limatahu et al., 2018; Maison et al., 2019;

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Saban et al., 2019; Ilma et al., 2020; Inayah et al., 2020; Ping et al., 2020; Molefe & Aubin, 2021; Zorluoğlu et al., 2022; Molefe & Aubin, 2023).

Learning based on science process skills is very influential in developing students' learning abilities (Harahap et al., 2016). So far, students have only been able to answer some basic knowledge by being given material, example questions, exercises and exams. Finally, students are able to answer questions, but science process skills such as analyzing various science topics and applying complex and abstract concepts and communicating them still tend to be low (Fahmi, 2018).

The learning process requires students to integrate new information into the cognitive structures they already have to produce a thinking process in achieving knowledge (Fahmi & Irhasyuarna, 2017). In this case, science learning does not only require knowledge as a product, but also emphasizes the thinking process (Putri et al., 2021; Fahmi et al., 2022). Therefore, science learning must be changed to use science process skills which are demonstrated by students knowing the tools, methods and procedures used and applying them in the discovery process and communicating them based on the evidence they obtain.

Strategies for implementing this include in the learning process, teachers providing provisions to improve science process skills to students (Gibson & Chase, 2002; Simsek & Kabapinar, 2010; Af'idayani et al., 2018). Through science process skills, students have the opportunity to interact with the learning environment which allows them to build understanding based on fact findings which are then used to form scientific concepts. Learning like this will make students active, change learning habits that were previously centered on the teacher so that the reference point is the students and ultimately make learning more meaningful (Fahmi et al., 2019).

The use of science process skills will make it easier for students to understand complex and abstract concepts if accompanied by concrete examples (Dimyati & Moedjiyono, 2002; Irhasyuarna et al., 2022). This will help students directly discover concepts rather than just memorizing the details of living and inanimate objects. In the end, the topic can be understood concretely and learning becomes more memorable and meaningful (Norhasanah et al., 2022).

Improving students' science process skills is not an easy thing. In the implementation process, to improve students' science process skills, teachers must innovate learning in the form of using learning models that suit the characteristics of the material to be taught (Lindquist, 2001). Among the learning models that are suitable for improving science process skills is the use of discovery-based learning models (Iswatun et al., 2017).

The inquiry model emphasizes activities or processes that take place during learning, thereby providing opportunities for students to discover and investigate the concepts contained in the material that will be taught to students to foster a scientific attitude. This can foster students' intrinsic motives because they feel satisfied with their own experiences in the learning they do (Rahayu et al., 2018). Because what you do yourself will be easily remembered and stored in your brain's memory for a long time (Fahmi et al., 2021).

Learning using the inquiry model is also very suitable for cognitive material (Andi, 2014). Among those that are suitable for use with this model are object classification materials. Because this topic directs direct observation activities to later carry out initial hypotheses as a characteristic of learning using the inquiry model, to then enter the next learning stage (Fahmi, 2018).

Data from previous research by Wu et al. (2006), Sullivan (2008), Simsek et al. (2010), Lati et al. (2012), and Af'idayani et al. (2018) shows that inquiry learning can improve science process skills and student learning outcomes. Other research conducted by Stout (2001), Lindquist (2001), Martin-Hansen (2005), and Schwartz (2007) shows that the effects of using inquiry in the learning process can improve students' understanding and science process skills. Subsequent research conducted by Ogan-Bekiroglu et al. (2014) showed that not only did students' science process skills improve by using the inquiry model, but there was also an increase in students' conceptual understanding of the material being taught. Therefore, this research was designed to see how learning outcomes using the inquiry model are seen in terms of science process skills and student learning outcomes.

Method

Initial Research Ideas

One of the initial principles underlying this research is the results of a survey of the learning process in schools in the city of Banjarmasin. The survey was conducted by observing the learning process carried out by the teacher, the feedback made by students and their learning results. The results of these observations become initial stage data before carrying out the research design. Researchers also reviewed a lot of literature about learning using the inquiry model, and designed what if learning using this model was used in schools.

The initial principle seen by researchers is the tendency for teachers' teaching methods to be still textual, so that teachers tend to be very active and students are passive. When learning takes place, students only carry out what is ordered by the teacher, without any equal reciprocal interaction process, so the

tendency of students is to memorize the lesson or what the teacher conveys. This then has an impact on students' weak level of knowledge and low science process skills. Among the visible indicators are student learning outcomes which are still low.

In scientific studies, after conducting many searches about learning using the discovery model, it was discovered that the discovery model was very influential in increasing students' learning motivation, knowledge and skills (Qing et al., 2010; Bayram et al., 2013). The ultimate goal of using this model is that students are able to fully understand the concepts they are studying, each learning step to achieve knowledge and skills and satisfactory learning outcomes.

Research Design

The research was conducted at the State Junior High School in Banjarmasin. Learning is carried out on class VII students with an age range of 12-13 years. The research was conducted within 12 weeks, in accordance with the school learning curriculum. The research method used is a combination of quantitative and qualitative methods designed using a pretest-posttest control group as in Figure 1. Quantitative research is used to determine the effectiveness of learning outcomes and science process skills results on the inquiry learning model, while qualitative research is used to see student responses during the learning process.

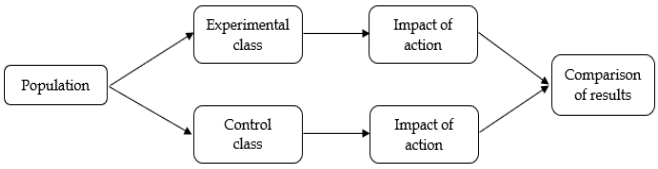

Figure 1. Flow of research implementation

The pretest-posttest control group was carried out on two different classes selected to represent the population. In detail, the research design is described in Table 1.

Table 1. Pretest-posttest Control Group Research Design

Class	Pretest	Treatment	Posttest
Experimental Class	O_1	X_1	O_2
Control Class	O_1	X_2	O_2

Information:
O_1 = Initial testing (pretest) before learning
O_2 = Final testing (posttest) after learning
X_1 = Treatment in learning using inquiry model learning tools
X_2 = Treatment in learning using conventional learning tools

Result and Discussion

Research Implementation

The research process was carried out by carrying out three stages of activities, namely Pretest, Treatment and Posttest. The pretest was carried out on all students with the aim of finding out the initial abilities of the students who would be the object of this research.

After the pretest was carried out, the research continued by giving different treatments to the experimental class and the control class. The learning process carried out in the experimental class uses the inquiry method, while in the control class uses a general conventional model. During the learning process at four meetings, efforts were made to implement all aspects of the inquiry method, namely starting with students formulating problems (making questions) based on the illustrations provided, making hypotheses, conducting experiments to find answers, making conclusions after which the results of the work were presented.

Effectiveness in Science Process Skills

Data from tests on the effectiveness of students' science process skills were tabulated and a normality test was carried out with the test results as in Table 2 below.

Table 2. Normality Test of Science Process Skills

Factor		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Mark	Experiment	.174	25	.049	.899	25	.017
	Control	.229	25	.002	.866	25	.004

Based on the normality test, it was found that the data were not normally distributed. Because the data is not normal, for the paired sample t test you can use the Wilcoxon test as an alternative choice. The Wilcoxon test is used to determine whether there is a difference in the means of two paired samples. The results of the Wilcoxon test on science process skills are presented in Table 3.

Based on the results of the Wilcoxon test, it shows that there is a significant difference between the pretest and posttest. This indicates that the inquiry model is considered to have an impact on the development of science process skills in students. Students were initially confused about solving questions regarding science process skills, but after learning the inquiry model, they were able to solve them. This cannot be separated from the activity of filling out the LKPD, where student activities can be seen that reflect the inquiry model learning stage, namely formulating problems, formulating hypotheses, collecting data, analyzing data and making conclusions, thereby bringing out students' science process skills. Science process skills are thinking

skills used to solve problems and formulate results (Ozgelen, 2012; Af'idayani et al., 2018).

Table 3. Wilcoxon Signed Ranks Test on Science Process Skills

	Posttest-Pretest
Z	-4.375
Asymp. Sig. (2-tailed)	.000

Apart from that, the use of inquiry model learning which involves the stages of the inquiry process can help students improve their science process skills so as to help students discover concepts that are not just memorized but also last a long time and even leave an impression in students' memories. This is in accordance with research by Simsek & Kabapinar (2010) and Bekiroglu & Arzu (2013) which states that inquiry-based learning can improve students' conceptual understanding and develop students' science process skills.

Effectiveness on Learning Outcomes Tests

Data from the learning outcomes test results were tabulated for normality testing with the results shown in Table 4 below.

Table 4. Normality Test Learning Results Test

Factor		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Mark	Experiment	.298	25	.000	.790	25	.000
	Control	.251	25	.000	.799	25	.000

The increase in learning outcome scores shows that there is a real increase in students' understanding and comprehension between the experimental class and the control class. However, the normality test shows that the data distribution is not normal, so we can see the effect of the data using the Wilcoxon test as in Table 5.

Table 5. Wilcoxon Signed Ranks Test on Learning Outcomes Test

	Posttest – Pretest
Z	-4.409[b]
Asymp. Sig. (2-tailed)	.000

Based on the results of the Wilcoxon test, the p value < 0.05 shows that there is a significant influence of the inquiry model on student learning achievement tests. This can be understood as inquiry learning can improve learning outcomes because the steps in inquiry learning encourage students to explore and discover for themselves the learning concepts they are studying. This causes students to experience a more memorable learning experience so that the concepts they discover for themselves are easier for them to remember and understand.

This is in accordance with constructivism theory which states that knowledge is formed not only from objects but also depends on the individual himself as a subject who captures every object observed. Therefore, knowledge is not static but dynamic depending on the individual who sees and constructs it (Sanjaya, 2011). Based on research by Rahayu et al. (2018), stated that inquiry-based learning can improve students' cognitive abilities. The same thing was also stated by Nuangchaleum et al. (2009) and Koksal et al. (2012) in their research. Apart from that, according to the research results of Bekiroglu et al. (2013) and Af'idayani et al. (2018) that inquiry-based learning can improve students' conceptual knowledge abilities and science process skills. Lati et al. (2012) also stated the same thing in their research results, namely that inquiry science activities were effective in improving student learning outcomes. Likewise, Abdi (2014) stated that students taught using inquiry-based learning had higher learning outcomes than students taught using traditional methods.

In general, the research results show that inquiry-based learning has a positive impact on improving science process skills and student learning outcomes. This increase is also supported by increased cognitive and conceptual knowledge abilities of students. These results are also in accordance with the principles of constructivism which emphasize that knowledge is formed through individual mental activity in constructing understanding of the objects being observed.

In general, the application of the inquiry model has a positive impact on increasing the effectiveness of learning, because it can improve the quality of learning. Apart from that, the specific positive impact of implementing inquiry-based learning is manifested in improving science process skills and student learning outcomes. Students become more active in learning, learning is more relevant for students, students are actively involved in the learning process, asking questions, observing and solving problems. The application of inquiry-based learning also strengthens students' affective perspectives through their interactions with the surrounding environment. Students experience the process of building their understanding through exploration and discovery, rather than just passively receiving information. These results can be a basis for developing educational practices in the future to optimize the application of learning that is more oriented towards active learning, inquiry and constructivism to achieve the goal of improving the quality of education.

Conclusion

The inquiry learning model is taught by organizing students into a situation that will raise questions, hypotheses, and also make students have knowledge and develop it until it becomes a complete concept. Researchers and practitioners have proven that the inquiry learning model is able to improve students' learning skills from a cognitive, psychomotor and affective perspective. This research proves that there is an effective influence on students after receiving systematic inquiry treatment in their learning. Quantitatively, it was found that the inquiry learning model was able to improve science process skills and student learning outcomes. On the other hand, the application of this learning model still needs to be optimized to achieve the goal of improving the quality of education.

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The authors declare no conflict of interest in this research.

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