PAIDAGOGIA:
Jurnal Inovasi Penelitian dan Pembelajaran
https://paidagogia.lombokinstitute.com/index.php/JIPP

Vol. 1. No. 1 (June 2024)
E-ISSN: 3063-8704
pp. 7-13

The Effect of The Team-Assisted Individualization Learning Model on Students' Science Process Skills and Cognitive Learning Outcomes

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Abstract: This study aims to determine the influence of the Team Assisted Individualization (TAI) learning model on students' science process skills and cognitive learning outcomes. Employing a quasi-experimental design with a nonequivalent control group design, the research population consists of all tenth-grade students at Madrasah Aliyah Qamarul Huda Bagu, Central Lombok, with a sample size of 49 individuals. Observation sheets are utilized to measure science process skills, while students' cognitive learning outcomes are assessed through a learning achievement test. The data on science process skills are tabulated and categorized as follows: high (80-100%), medium (60-79%), and low (0-59%). The student's learning outcomes are tabulated and analyzed using covariance (ANCOVA) analysis to discern differences between the experimental and control classes. Implementing the TAI model in teaching effectively enhances science process skills and students' learning outcomes (Sig.<.05). The students' science process skills fall within the medium category. Successful TAI implementation requires meticulous planning, teacher support, and coordination among team members. Additionally, factors such as group size, students' proficiency levels, and available resources can influence the effectiveness of TAI in education. Hence, educators must carefully consider TAI implementation in the classroom to maximize its impact on student motivation and cognitive learning outcomes.

Article History
Received : 13-02-2024
Revised : 15-04-2024
Accepted : 01-05-2024
Published : 29-06-2024

Key Words :
Team Assisted Individualization; Process Skills; Cognitive Learning Outcomes.

How to Cite: Mardiati, M., & Karmana, I. W. (2024). The Effect of The Team-Assisted Individualization Learning Model on Students' Science Process Skills and Cognitive Learning Outcomes . *PAIDAGOGIA: Jurnal Inovasi Pendidikan Dan Pembelajaran,* *1*(1). Retrieved from https://paidagogia.lombokinstitute.com/index.php/JIPP/article/view/6

Introduction

Education is crucial in developing students' scientific process skills and cognitive learning outcomes (Asy'ari & Fitriani, 2017; Khaerani et al., 2020). Various learning models have been developed and implemented to achieve this goal in various educational institutions. One exciting learning model is Team Assisted Individualization (TAI) (Setiawan et al., 2020). The TAI model combines group learning elements with an individualized approach, creating a dynamic learning environment responsive to individual needs (Cahyaningsih, 2018; Novalinda et al., 2020). In this context, research on the influence of the TAI learning model on students' scientific process skills and cognitive learning outcomes has become an increasingly interesting topic for educational researchers.

The importance of scientific process skills cannot be overstated in the current educational context. These skills include students' ability to observe, collect data, formulate hypotheses, conduct experiments, and analyze results (Turiman et al., 2012; Jirout &

Zimmerman, 2015; Prayitno et al., 2017). On the other hand, cognitive learning outcomes encompass understanding and mastery of fundamental scientific concepts (Adams, 2015; Shi et al., 2020). Therefore, the influence of the TAI learning model on students' scientific process skills and cognitive learning outcomes is a primary concern in efforts to improve the quality of education. Previous research has revealed various findings related to the impact of this learning model. Evidence suggests that the TAI model can enhance students' scientific process skills by providing individual support to pursue their learning goals (Hanik et al., 2019; Angkowati, 2022). Additionally, the group approach in this model enables students to learn cooperatively, expand their understanding through social interaction, and facilitate the exchange of creative ideas.

However, not all studies produce findings consistent with the positive impact of TAI on students' scientific process skills and cognitive learning outcomes. Some studies note that its effects may vary depending on contextual factors, such as proper implementation and teacher qualifications. Therefore, it is vital to delve deeper into the influence of this learning model to understand the factors affecting its outcomes. Further research on the impact of the TAI learning model on students' scientific process skills and cognitive learning outcomes is crucial for developing a deeper understanding of the potential of this model in improving educational quality. This research can also provide practical guidance for educators and policymakers to develop more effective learning strategies to optimize students' scientific and cognitive learning at various educational levels. This research describes the results of implementing the TAI learning model on students' scientific process skills and cognitive learning outcomes and the factors influencing its implementation.

Research Method

This study employs a quasi-experimental design. A quasi-experiment is a type of research that includes a control group but cannot fully function to control extraneous variables that influence the experiment's implementation (Sugiyono, 2014). The research design utilizes the Nonequivalent Control Group Design. A Nonequivalent Control Group Design is an experimental method where two compared groups are not randomly selected. The experimental group receives a specific treatment or intervention, while the control group does not receive the treatment. The research design is presented in Table 1.

Table 1 Research Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_3	X_2	O_4

Note :
X1: Learning with the TAI model
X2: Learning with conventional models.
O1: Pretest in the experimental class
O2: Posttest in the experimental class
O3: Pretest in the control class
O4: Posttest in the control class

This study's population comprises all class X MA Qamarul Huda Bagu students in the academic year 2014/2015. The sample was taken using a total sampling technique or saturated sample, where all population members were taken as samples. This research utilizes two experimental classes, one as the experimental group and the other as the control group.

The total number of samples consists of 49 students, with class XA1 as the experimental group and class XA2 as the control group.

This study employs observation sheets to measure students' science process skills, while cognitive learning outcomes are calculated using a learning outcomes test. The observation sheet adopts Fitriana's (2019) instrument for measuring science process skills. Data on science process skills are then tabulated, and scores are categorized into high (80-100%), medium (60-79%), and low (0-59%). The learning outcomes test consists of 40 questions about the taught and task material. The questions are drawn from textbooks or relevant references. Student learning outcome data are tabulated and analyzed using ANCOVA (Khammar et al., 2018) to determine the difference in student learning outcomes between the experimental and control classes. Data analysis is facilitated using SPSS 16 for Windows software (Bala, 2016).

Result and Discussion

This study examines the influence of the TAI model on students' science process skills and cognitive learning outcomes. The analysis results of students' science process skills are presented in Table 2.

Table 2 Science Process Skills of the Experimental Class Group

Group	Percentage (%)	Category
1	76,5	Medium
2	69	Medium
3	76,2	Medium
4	70,6	Medium
5	74,5	Medium
6	66	Medium
Average	72.2	Medium

Table 2 illustrates that the percentages of science process skills vary among the groups. The lowest percentage is found in Group 6, with a value of 66%, while the highest is in Group 1, with a percentage of 76.5%. Overall, students' average science process skills are 72.2%, categorized as moderate. These results indicate that the TAI model influences students' science process skills.

The TAI model is an instructional approach that integrates collaborative learning elements within a team with individual learning approaches. In the context of teaching science process skills, the TAI model may positively impact skill development. Several potential effects may occur (a) Enhanced Collaboration: The TAI model encourages students to work in teams, fostering their ability to collaborate, share ideas, and work together to achieve common goals. Collaboration is crucial in scientific research and experiments often conducted by teams of scientists; (b) Improved Problem-Solving Skills: In the TAI model, students are often tasked with solving problems within teams. This can help them develop analytical, synthesis, and problem-solving skills required in the scientific process; (c) Development of Communication Skills: The model also emphasizes communication among team members. Good communication skills are essential in science, especially when communicating research or experiment results to others; (d) Enhanced Research Skills: In the TAI model, students may be asked to conduct more in-depth research. This can help them better understand the scientific research process, including hypothesis formulation, data collection, and result analysis; and (e) Increased Self-Directed Learning: While there is a collaborative element, the TAI model also encourages students to take personal responsibility for their learning. This can help them become more independent in developing science process skills (Prince, 2004; Michaelsen & Sweet, 2008; NRC, 2012; Tanner, 2013; Johnson et al., 2014).

The description of posttest student learning outcomes is presented in Figure 1. The posttest data were further analyzed through covariance analysis to determine the influence of the TAI model on student learning outcomes. Figure 1 illustrates the differences in student learning outcomes between the experimental and control classes. The lowest value in the control class is 40, while the highest is 80. In the experimental class, the lowest value is 60, while the highest is 95. The average learning outcomes of the experimental class are higher than those of the control class, at 77.4 and 60, respectively. Overall, student learning outcomes in the experimental class are higher than in the control class. These results need to be reinforced through covariance analysis. To support covariance analysis, tests of normality and homogeneity prerequisites are displayed in Table 3, while the covariance analysis results are shown in Table 4.

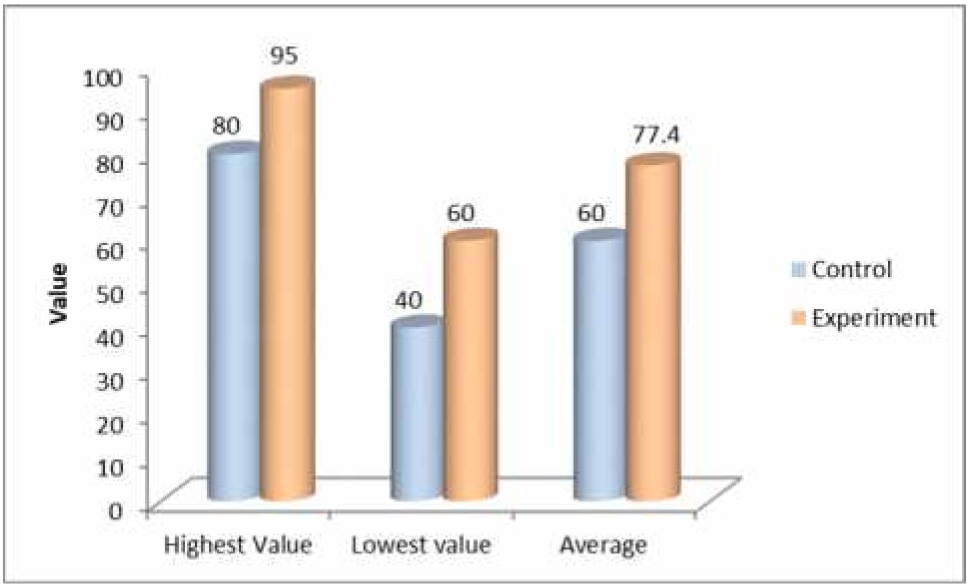

Figure 1. Student learning outcomes

Table 3. Results of pretest and posttest normality and homogeneity tests

Variable	Normality test (Kolmogorov-Smirnov)			Homogeneity test			
	Statistic	Df	Sig.	*Levene Statistic*	df1	df2	Sig.
Pretest_ TAI Model	.117	27	.200	.637	1	47	.429
Pretest_Conventional Model	.206	22	.016				
Posttest_ TAI Model	.269	27	.000	2.225	1	47	.142
Posttest_ Conventional Model	.212	22	.064				

The normality and homogeneity analysis results in Table 3 indicate that the data for the TAI pretest_model and Conventional posttest_model are normally distributed and have homogeneous variances. However, other data, such as the Conventional pretest_model and

TAI posttest_model, are not normally distributed. Having fulfilled one of the prerequisite tests, a covariate analysis is then conducted, presented in Table 4.

Table 4. Covariate analysis results.

	Type III sum of Squares	Df	Mean Square	F	Sig.
Corrected model	4761.812	2	2380.906	27.518	.000
Intercept	8047.769	1	8047.769	93.014	.000
Pretest	1088.493	1	1088.493	12.580	.001
Learning model	1661.145	1	1661.149	19.199	.000
Error	3980.025	46	86.522		
Total Corrected	246050.000	49			
Total	8741.837	48			

The results of the covariate analysis in Table 4 indicate that there is an influence of the learning model on students' cognitive learning outcomes (Sig.<.05). These findings suggest that the cognitive learning outcomes of students in the experimental class taught using the TAI model are higher compared to the control class taught using conventional methods. TAI is an approach that focuses on a combination of group learning with an emphasis on individual student needs. Students' increased cognitive learning outcomes are likely due to the following factors: (a) Enhanced Conceptual Understanding: TAI can positively impact students' conceptual understanding. When students work in teams and explain the material to each other, they tend to understand better and internalize the information. This is particularly true for complex concepts, as discussing with peers can help unravel complex ideas. This is supported by previous research indicating that TAI implementation in learning can improve students' conceptual understanding (Jannah et al., 2019; Rahmayanti et al., 2020); (b) Enhanced Motivation: Collaboration in TAI can enhance student motivation. They feel more engaged in learning because they feel personally responsible for achieving their learning goals. This can reduce boredom and increase their interest in learning. This is reinforced by Putri (2018), who reported increased student motivation when taught using the TAI model. Increased conceptual understanding and student motivation are suspected factors that can enhance students' cognitive learning outcomes.

Although there is ample evidence supporting the positive influence of TAI on students' cognitive learning outcomes, it should be noted that successful implementation requires good planning, teacher support, and team member coordination. Additionally, factors such as group size, students' proficiency levels, and available resources can also affect the effectiveness of TAI in specific learning contexts. Therefore, it is important for educators to carefully consider implementing TAI in the classroom to maximize its benefits for students' cognitive learning outcomes.

Conclusion

Implementing TAI in education requires careful planning, teacher support, and team member coordination. Additionally, factors such as group size, students' proficiency levels, and available resources can also affect the effectiveness of TAI in education. Therefore, it is crucial for educators to carefully consider the implementation of TAI in the classroom to maximize its impact on student's motivation and cognitive learning outcomes.

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E-ISSN: 3063-8704
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