

The Effect of the Dapic Problem-Solving Process Learning Model on Students' Critical Thinking Skills in Colloid System Material

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ABSTRACT

This study aims to examine the effect of the DAPIC Problem-Solving Process learning model on students' critical thinking skills in colloid system material. The DAPIC model consists of five stages: Define, Assess, Plan, Implement, and Communicate, designed to help students develop critical thinking skills through a structured learning process relevant to everyday life. The research employs a quantitative approach, measuring critical thinking skills based on indicators developed by Ennis (1995). The method used is a quasi-experimental design with a nonequivalent control group design. The sampling technique is purposive sampling, with 32 students in each group: class XI-2 as the experimental group and class XI-1 as the control group. The research instrument is an essay test adapted to Ennis's critical thinking indicators. The results show that the significance value (Sig.) is $0.000 < \alpha (0.05)$, leading to the rejection of H_0 and acceptance of H_1 . This indicates that the DAPIC Problem-Solving Process learning model significantly affects students' critical thinking skills in colloid system material.

Keywords: Critical thinking, DAPIC Problem-Solving Process model, Colloid system.

ABSTRAK

Penelitian ini bertujuan untuk mengkaji pengaruh model pembelajaran DAPIC *Problem-Solving Process* terhadap kemampuan berpikir kritis siswa pada materi sistem koloid. Model DAPIC terdiri dari lima tahap: Mendefinisikan, Menilai, Merencanakan, Melaksanakan, dan Berkomunikasi, yang dirancang untuk membantu siswa mengembangkan keterampilan berpikir kritis melalui proses pembelajaran terstruktur yang relevan dengan kehidupan sehari-hari. Penelitian ini menggunakan pendekatan kuantitatif, mengukur keterampilan berpikir kritis berdasarkan indikator yang dikembangkan oleh Ennis (1995). Metode yang digunakan adalah desain kuasi-eksperimental dengan desain kelompok kontrol yang tidak setara. Teknik pengambilan sampel adalah *purposive sampling*, dengan 32 siswa di setiap kelompok: kelas XI-2 sebagai kelompok eksperimen dan kelas XI-1 sebagai kelompok kontrol. Instrumen penelitian adalah tes esai yang disesuaikan dengan indikator berpikir kritis Ennis. Hasil penelitian menunjukkan bahwa nilai signifikansi (Sig.) adalah $0,000 < \alpha (0,05)$, yang mengarah pada penolakan H_0 dan penerimaan H_1 . Hal ini menunjukkan bahwa model pembelajaran Proses Pemecahan Masalah DAPIC secara signifikan mempengaruhi kemampuan berpikir kritis siswa dalam materi sistem koloid.

Kata kunci: Berpikir kritis, model Proses Pemecahan Masalah DAPIC, Sistem koloid.

INTRODUCTION

Critical thinking skills have become a necessity for every individual living in the 21st century, especially in the era of the Industrial Revolution 4.0. This

underscores the importance of critical thinking skills in education, making it an essential requirement for students. Consequently, educators need to develop this ability among their students (Zakiah & Lestari, 2019).

According to Ennis, "*critical thinking is reasonable and reflective thinking focused on deciding what to believe or do,*" meaning that critical thinking is a reflective process of deciding what to believe or do. Critical thinking skills, as described by Redecker, include the ability to access, analyze, and synthesize information—skills that can be taught, practiced, and mastered (Ennis, 1996).

The low level of critical thinking skills among students in chemistry learning was revealed through observations conducted by researchers with the assistance of chemistry teachers. The results indicated that students' average critical thinking ability is very low. According to PISA data, Indonesian students can only achieve level 1 and level 2 out of 6 levels of questions, leading PISA to conclude that Indonesian students' critical thinking skills are very poor (Schleicher, 2019).

Teaching models significantly impact students' thought processes. Effective teaching models can help students develop their cognitive abilities and critical thinking skills. Conversely, inappropriate teaching models may hinder students' cognitive development (Joyce et al., 2015).

In line with the general learning outcomes (CP) of Phase F in the independent curriculum, students are expected to explain the application of various chemistry concepts in everyday life. Learning about colloidal systems is one of the main topics in chemistry with significant relevance to daily life and the industrial sector. In this context, critical thinking skills are crucial for understanding colloidal systems, as the principles of colloids can be applied to produce colloidal products or other products created through these processes (Setyawan, Roshayanti, & Novita, 2023).

To address these issues, a suitable teaching model aligned with the learning material is needed to enhance students' critical thinking skills. One teaching model expected to improve critical thinking skills is the DAPIC Problem Solving Process Model, which consists of five stages: Define, Assess, Plan, Implement, and Communicate (Loep, 1998).

RESEARCH METHODS

The research method used in this study is **quantitative research with a quasi-experimental design**. "Quasi" refers to something that is not entirely authentic; therefore, the results of quasi-experimental research can be defined as a pseudo-experiment. This is due to time constraints and the inability of the researcher to fully control external variables that influence the execution of the experiment (Kurniawan, 2018).

Research design

The research design used is the Nonequivalent Control Group Design, presented in the table below (Sugiyono, 2019).

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experimental Class	O1	X1	O2
Control Class	O3	X2	O4

Explanation:

X : Treatment using the DAPIC Problem Solving Process learning model.

O1,3 : Pretest results of the experimental and control groups before the treatment.

O2,4 : Posttest results of the experimental and control groups after the treatment.

Research site and participants

This research was conducted at SMA Al-Atiqiyah, and the study took place in September 2024. The population of this research consists of 64 students from class XI. In this study, there are two classes: a control class and an experimental class, both of which were given pretests and posttests to compare the results. The difference is that the experimental class received treatment, while the control class did not. The research sample includes XI students divided into two classes: XI-1 as the control class and XI -2 as the experimental class. The determination of the experimental and control classes was done using purposive sampling, which is a sampling technique based on specific considerations (Kurniawan, 2018).

The research instrument used in this study consisted of 11 essay questions administered in the form of a pretest and a posttest. The data obtained from this research were subsequently analyzed using statistical tests, including normality tests, homogeneity tests, and hypothesis tests (Independent Sample T-Test).

Data collection and analysis

The study was conducted in four stages: the preliminary stage, the preparation stage, the implementation stage, and the completion stage.

RESULTS AND DISCUSSION

1. Research Results: Test Scores

Table 2. Pretest Scores for Experimental and Control Classes

Data	Pretest	
	Experimental Class	Control Class
N	32	32
Minimum Score	4	4
Maximum Score	22	22
Average Score	9.8	10.3

The data in Table 2 shows the pretest scores for the experimental and control classes. In the experimental class, the average pretest score was 9.8, with the highest score being 22 and the lowest score being 4. In contrast, the

control class had an average pretest score of 10.1, with the highest score being 22 and the lowest score being 4. Comparing the experimental and control classes, there is a difference of 0.3 in the average pretest scores before the treatment was administered.

Table 3. Posttest Scores for Experimental and Control Classes

Data	Posttest	
	Experimental Class	Control Class
N	32	32
Minimum Score	33	4
Maximum Score	96	78
Average Score	63.8	55.4

Table 3 shows the posttest scores for the experimental and control classes. After the treatment was given, the posttest results revealed a significant difference between the experimental and control classes. In the experimental class, the average posttest score was 63.8, with the highest score being 96 and the lowest score being 33. In the control class, the average posttest score was 55.4, with the highest score being 78 and the lowest score being 4. The data indicates that the average posttest score in the experimental class was 8.4 points higher than in the control class. This suggests that the learning outcomes for students in the experimental class were better compared to those in the control class.

2. Achievement of Learning Indicators Based on Pretest and Posttest Scores

Table 4. Achievement of Learning Indicators Based on Pretest and Posttest Scores

No	Indicator	Control Class		Experimental Class	
		Pretest	Posttest	Pretest	Posttest
1.	Focusing on questions	33,3%	65,6%	26%	71,9%
2.	Analyzing arguments	0%	67,2%	0%	75%
3.	Asking and answering questions	20,3%	82,8%	9,4%	85,9%
4.	Considering the credibility of a source	18,7%	56,2%	14,6%	67,7%
5.	Observing and evaluating observational results	2,1%	52,1%	6,2%	67,7%
6.	Making deductions and evaluating deductions	0%	67,2%	1%	83,3%
7.	Making inductions and evaluating inductions	0%	68,7%	0%	70,3%

8.	Formulating and evaluating decision values	0%	7,3%	0%	14,6%
9.	Identifying terms and considering definitions	31,2%	62,5%	39,1%	62,5%
10.	Identifying assumptions	0%	18,7%	0%	23,4%
11.	Deciding on an action	4,7%	85,9%	12,5%	85,9%
	Average	10,3%	57,1%	9,8%	64,4%

Based on Table 4, the data indicates that the average percentage of achievement for learning indicators from the pretest shows that the control class had a higher average percentage (10.3%) compared to the experimental class (9.8%). However, after the treatment was applied, the experimental class achieved a higher average percentage of learning indicators in the posttest (57,1%) compared to the control class (64,4%). This improvement demonstrates that the treatment in the experimental class had a more significant impact on achieving the learning indicators.

3. Results of Normality Tests for Pretest and Posttest

Table 5. Normality Test Results for Pretest

Class	Data			Conclusion
	n	Sig.	α	
Control	32	0,129	0,05	Sig > 0,05 (Data is normally distributed)
Experimental	32	0,114	0,05	

Based on Table 5, the normality test results for the pretest show a significance value of 0.114 for the experimental class and 0.129 for the control class. Both significance values are greater than the alpha level of 0.05 (Sig. > 0.05). Therefore, it can be concluded that the pretest data for both classes are normally distributed.

Table 6. Normality Test Results for Posttest

Class	Data			Conclusion
	n	Sig.	α	
Control	32	0,267	0,05	Sig > 0,05 (Data is normally distributed)
Experimental	32	0,11	0,05	

According to Table 6, the normality test results for the posttest show a significance value of 0.11 for the experimental class and 0.267 for the control class. Both significance values are greater than the alpha level of 0.05 (Sig. > 0.05). Thus, it can be concluded that the posttest data for both classes are normally distributed.

4. Results of Homogeneity Tests for Pretest and Posttest

Table 7. Homogeneity Test Results for Pretest

Test Type	Statistic			Sig. (α)	Conclusion	
	<i>Levene Statistic</i>	df1	df2			Sig.
<i>Pretest</i>	3,661	1	32	0,22	0,05	Sig. > 0,05 (Data is homogeneous)

Table 7 indicates that at a 5% significance level ($\alpha = 0.05$), the significance value for the pretest is 0.22. This value is greater than 0.05 (Sig. > 0.05), suggesting that the pretest data variance for the experimental and control classes is homogeneous.

Table 8. Homogeneity Test Results for Posttest

Test Type	Statistic			Sig. (α)	Conclusion	
	<i>Levene Statistic</i>	df1	df2			Sig.
<i>Posttest</i>	3,661	1	32	0,21	0,05	Sig. > 0,05 (Data is homogeneous)

Table 8 shows that at a 5% significance level ($\alpha = 0.05$), the significance value for the posttest is 0.21. This value is greater than 0.05 (Sig. > 0.05), indicating that the posttest data variance for the experimental and control classes is homogeneous. The criterion used for making conclusions is that if the calculated F-value is greater than the table F-value, the variance is considered homogeneous; if the calculated F-value is less than the table F-value, the variance is considered non-homogeneous.

5. Hypothesis Test Results for *Pretest* dan *Posttest*

Table 9. T-Test Results for Pretest

Data	Sig. (α)	Asymp.Sig. (2-tailed)	Conclusion
<i>Pretest</i>	0,05	0.862	No significant difference in pretest scores between the two classes (Sig. 0,862 > 0,05)

Based on the T-test (Independent Sample T-Test) results shown in Table 9, the Asymp. Sig. (2-tailed) value is 0.862. This indicates that there is no significant difference in the average pretest scores between the experimental and control classes. According to the rule, if Sig. (2-tailed) > 0.05, then H0 is accepted and H1 is rejected. Since the Asymp. Sig. value is greater

than 0.05, H0 is accepted and H1 is rejected. This means there is no significant difference in the initial abilities of students between the experimental and control classes based on the pretest scores, making the samples appropriate for further analysis.

Table 10. T-Test Results for Posttest

Data	Sig. (α)	Asymp.Sig. (2-tailed)	Conclusion
<i>Posttest</i>	0,05	0,000	There is a significant effect (Sig. (2-tailed) < 0.05), H1 is accepted

According to the T-test (Independent Sample T-Test) results in Table 10, the Asymp. Sig. (2-tailed) value is 0.000. This result shows a significant difference in the average posttest scores between the experimental and control classes. According to the rule, if Sig. (2-tailed) < 0.05, then H0 is rejected and H1 is accepted. Since the Asymp. Sig. value is less than 0.05, H0 is rejected and H1 is accepted. This indicates that the DAPIC Problem Solving Process model has a significant effect on students' learning outcomes in the colloid system material.

Discussion

Based on the prerequisite analysis test of the pretest data from both classes, the results showed that the data were normally distributed and had homogeneous variance. After conducting the prerequisite analysis test, a t-test was performed. The results of the t-test showed Sig > α , namely 0.849 > 0.05, indicating that H0 was accepted (Nuryadi et al., 2017). This means that there was no difference in critical thinking skills between the two classes. Therefore, both classes were deemed suitable as research samples. This aligns with the study by Asiyah et al. (2021), which found that the initial abilities of students in both classes were the same.

The average pretest score served as the basis for determining the control and experimental classes. Class XI 1 had a higher average pretest score compared to Class XI 2. Therefore, the researcher decided that Class XI 2 would be the experimental class and Class XI 1 the control class. In line with the research by Maimunah (2022), it was found that based on the pretest results, the initial ability of the experimental class was lower than that of the control class, but the difference was not significant.

The learning process was conducted over three meetings in both the experimental and control classes. In the experimental class, the DAPIC Problem-Solving Process model proposed by Loep (1998) was implemented. This process consists of five stages: defining the problem, assessing the problem situation, planning how to solve the problem, implementing the plan, and communicating the results to others. This is in line with the research conducted by Abdulah and Retno Winarti (2022), which stated that the key to the DAPIC problem-solving process lies

in several essential elements, namely defining, assessing, planning, and implementing.

The prerequisite analysis test results showed that the data were normally distributed and had homogeneous variance, allowing for hypothesis testing to be conducted. The analysis yielded $\text{Sig} < \alpha$, namely $0.017 < 0.05$, indicating that H_0 was rejected and H_1 was accepted. Thus, it can be concluded that there is a difference in the posttest results between the control and experimental classes. This means that the hypothesis test conducted on both classes demonstrated that the DAPIC Problem-Solving Process learning model had an effect on the critical thinking skills of students in the experimental class.

This finding is consistent with research by Ika Putri Wulandari and Sugianto (2019), which concluded that the DAPIC Problem-Solving model can enhance students' critical thinking skills in solving problems. Additionally, it aligns with research by Duangsopa and Nuangchalerm (2024), which found that the implementation of deductive learning using the DAPIC approach (Define, Analyze, Plan, Implement) successfully improved problem-solving skills among 10th-grade students in Chemistry subjects.

CONCLUSIONS

Based on research conducted at SMA Al-Atiqiyah, the results of the hypothesis testing using parametric statistical analysis with the Independent Sample T-Test showed a Sig. (2-tailed) value of $0.017 < 0.05$, indicating that H_1 was accepted and H_0 was rejected. The acceptance of H_1 suggests that the application of the DAPIC Problem-Solving Process learning model had an impact on students' critical thinking skills in the colloid system material. From this, it can be concluded that the use of the DAPIC Problem-Solving Process learning model is more effective in enhancing students' critical thinking skills compared to the use of conventional learning models in the control class.

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