ISSN 2964-4291
https://proceeding.unnes.ac.id/index.php/iset

The Effectiveness of the PARAS Learning Model (Problems-Attention-Relevance-Assurance-Satisfaction) on the Ability to Think Geometry and Motivation for Student Achievement

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Abstract. The research was motivated by the results of previous research, namely that students only reached level 2 of Van Hiele's geometric thinking ability and the motivation for student achievement was low. So that the PARAS learning model was chosen, namely the modification of problems based learning and the ARCS model. The purpose of the study was to determine the effectiveness of the PARAS learning model on the ability to think geometry and motivation for student achievement. In this research design One-group Pretest-posttest Research Design. The population is mathematics education students of Bina Bangsa Serang University for the 2021-2022 academic year. The sample was selected using the purposive sampling technique, namely the second semester students, totaling 22 students. Data collection techniques with geometric thinking ability tests before and after learning and a questionnaire of motivation to excel after learning. The data analysisis the effect size test, percentage, chi-square test and contingency coefficient. In conclusion, it is known that the effectiveness of the PARAS learning model on students' geometry thinking ability is very high and students have been able to reach the deduction level. For the motivation for student achievement after being given learning with the PARAS learning model, it is concluded that the average is relatively high. Furthermore, it is known that there is no relationship between the motivation to excel and the student's geometric thinking ability. The implication of this study is a modified learning model that can improve the ability to think geometry and motivation for student achievement.

Key words: PARAS learning model; Geometry Thinking Ability; Motivation to Achieve

How to Cite: Hamidah, H., Zaenuri, Z., Isnarto, I., Agoestanto, A., Kusuma, J.W. (2022). The Effectiveness of the PARAS Learning Model (Problems-Attention-Relevance-Assurance-Satisfaction) on the Ability to Think Geometry and Motivation for Student Achievement. *ISET: International Conference on Science, Education and Technology* (2022), 258-265.

INTRODUCTION

In learning geometry, it is necessary to have the ability to think geometry, namely the ability of students in terms of observing objects, building definitions based on characteristics inherent in objects, recognizing relationships between one object and another object, and applying them in solving geometry problems (Esendemir & Bindak, 2019). Van hiele divides the ability to think geometry in five levels, namely level 0 (visualization), level 1 (analysis), level 2 (abstraction), level 3 (deduction), and level 4 (rigor) (Van Hiele, 1959). Karapınar & Alp İlhan (2018) mentioned the importance of studying geometry because it gives a more complete appreciation of the environment. The same thing was expressed by Karapınar & Alp İlhan (2018) who mentioned that geometry gives an important role to a person's ability to understand other concepts.

From the results of Şefik et al. (2018), Karapınar & Alp İlhan (2018), Asemani et al. (2017), Altun (2018), and Sugiyarti & Ruslau (2019) research, it is known that students are only able to reach the lowest level of the Van Hiele geometric thinking ability level, namely at the visualization level. Furthermore, the results of Şefik et al. (2018), Muhassanah & Mulyatna (2020), Putri & Nopriana (2019), Rafianti (2016), Fitriyani et al. (2018), and Decano (2017) research are known that students are able to reach the second level at the Van Hiele geometric thinking level, namely at the abstraction level.

The results of the study showed that students have not been able to reach the deduction level and rigor level. According to Haviger & Vojkůvková (2015) at the deduction stage it means having the ability to give deductive geometric evidence or draw conclusions deductively, while the rigor stage means having the ability to use all kinds of evidence, being able to describe the effect of adding or removing axioms on certain geometric systems. This shows that in general students have difficulty in doing proof problems, and to improve the student's level of geometric thinking, the student must be able to master the proof questions.

The expression can be because being used to it is a suitable situation for students' ability to understand the material or solve problems. Getting students used to solving proof questions is one way to overcome the student's difficulties. According to Qomariyah (2019), the series of learning activities that emphasize the problem-solving process have an influence in improving student learning outcomes, namely by inviting students to actively participate during learning and providing meaningful learning experiences for students. Tambunan (2019) and Liljedahl et al. (2016) also showed that learning with mathematical problem-solving strategies is effective in improving students' mathematical abilities. This is reinforced by the statement of teachers who have joined the national council of mathematics teachers (NCTM) since the 1980s who advocated problem solving should be the focus of school mathematics (Sobel & Maletsky, 1988).

In his book entitled "Mathematical Problem Solving", Schoenfeld (2014) wrote that carrying out mathematical problem-solving activities in learning is an important general thing as a means to advance thinking skills. However, not a few students show a sense of saturation with the monotonous learning process of continuously solving problems. In the learning process it is not enough just to be problem-based but it is very important to pay attention to how to motivate students during learning (Hwang et al., 2020), and (Li & Keller, 2018). A person who is low in motivation to achieve has anegative influence on his thinking ability.

The motivation of achievement is the power of motives to achieve success and avoid failure. The indicators are: a) Setting standards of excellence; b) Needs (motives); c) Probability (expectation) of success; d) Incentive value (pride in achievements) (Bhoke, 2018). There are several factors that affect the motivation for student achievement, some of which are the low ability of students to face competitiveness and the learning process is less interesting. According to Keller (1987) model ARCS learning is one of the motivational models consisting of attention, relevance, confidence, and satisfaction which is developed based on the expectancy value theory which contains two components, namely value (value) of the goal to be achieved and the expectation (expectancy) in order to successfully achieve that goal.

The results of Gray & Ross (2021) dissertation study suggested that to increase student geometry learning motivation, teachers should utilize the ARCS motivational model as an arrangement of learning processes to regulate student resource procedures and experiences towards geometry learning. Furthermore,based on the results of Karabatak & Polat (2020), Ma & Lee (2021), Izmirli & Sahin Izmirli (2015), and Li & Keller (2018) research, it is known that the ARCS motivation model is able to motivate students during learning and greatly affects their learning outcomes. Then the results of Sibiya, (2019), FİLİZ & GÜR (2021), dan Gray & Ross (2021) research found that the ARCS learning model is able to increase the motivation to learn geometry for students, make students more confident and show minat in learning geometry, it is also known that the level of achievement and perception of geometry concepts is higher than that of students with ordinary learning.

Based on the description above, the problem based learning process and ARCS learning model are a combination that is considered appropriate to hone students' ability to solve mathematical problems and continue to motivate students during the learning process to achieve their goals. This combination of researchers called the PARAS learning model, which stands for problem, attention, relevance, assurance, and satisfaction, namely by replacing the confidence component with assurance. The PARAS learning model is a learning model that researchers develop to hone students' problem-based thinking skills and maintain student motivation to try to achieve their goals which are arranged based on five components, namely problem, attention, relevance, assurance, and satisfaction. The learning process begins with providing geometry problems. Furthermore, to attract the attention of students (attention), students are divided into small groups to discuss and conduct questions and answers to solve the problems given. Still in an effort to maintain the attention of students in the learning process (attention), discussions and questions and answers continued between groups. Furthermore, after the discussion process between groups and finding answers to the initial problems, the lecturer explains andadapts the learning material to the problems discussed by students and conveys the benefits of knowledge / skills that will be obtained after studying the material (relevance). Then students are given practice questions that are done individually with a level of difficulty in order from the easiest first, in order to increase students' confidence in their own abilities (assurance). Finally, discussing practice questions that are considered difficult by giving students the opportunity to try to answer them in front of the class to cause a sense of satisfaction and pride in themselves (satisfaction).

The PARAS learning model is an effort by researchers to overcome student problems in achieving deduction levels and rigor levels in the ability to think geometry and increase student achievement motivation. The problem stages in the PARAS learning model will familiarize students with solving geometry problems, especially evidentiary questions. Furthermore, other stages play a role in motivating students to continue to be involved during the learning process and try to achieve their goals, namely solving the given problems. As a result, students will get meaningful learning and improve their geometry thinking skills to a higher level, namely the deduction level and the rigor level.

Based on the description above, this study aims to determine the effectiveness of the PARAS learning model on the ability to think geometry and motivation for student achievement. The formulation of the problem in this study is:

1. How is the effectiveness of the PARAS learning model on students' geometric thinking ability?
2. What is the motivation for student achievement after being given learning with the PARAS learning model?
3. Is there a relationship between the motivation to excel and the student's geometry thinking ability?

METHODS

This research is an experimental study with a One-group Pretest-posttest Research Design. The research was conducted for 6 meetings in the Field Geometry course. The population in this study were mathematics education students of Bina Bangsa Serang University, Banten, for the 2021-2022 academic year. The sample was selected using the purposive sampling technique , namely class 2A students in the second semester, totaling 22 students. Data collection techniques by providing geometric thinking skills tests before and after learning and providing a questionnaire of motivation for achievement after learning to students.

The instruments in this study are tests of geometric thinking skills and achievement motivation questionnaires. Tes geometric thinking ability consists of 25 multiple choice questions made based on five levels of geometric thinking ability namely level 0 (visualization), level 1 (analysis), level 2 (abstraction), level 3 (deduction), and level 4 (rigor) adopted from (Endorgan, 2020; Haviger & Vojkůvková, 2014; Van Hiele, 1959). Each level consists of 5 questions and students are said to be able to reach a certain level if they can answer at least 3 questions from the 5 questions. The achievement motivation questionnaire is made based on the indicators of achievement motivation, namely: a) Setting standards of excellence; b) Needs (motives); c) Probability (expectation) of success; d) The value of incentives (pride in achievement) is 20 statements, namely 5 statements each. The assessment of the achievement motivation questionnaire was carried out by instrument trials, namely using a content validity test with testing by 3 validators, namely two Indonesian lecturers and one Mathematics lecturer.

Data analysis was used to answer three problem formulations in this study. For the formulation of the first problem , namely to determine the effectiveness of the PARAS learning model on students' geometric thinking ability, it will be analyzed with an effect size test (Umam & Jiddiyyah, 2021):

$$d = \frac{M_2 - M_1}{S_{pooled}}$$

Information:
d : *Cohen's effect size*
M_1 : average *pretest* score
M_2 : average *posttest* score
S_{pooled} : standard combined deviation

The standard formula of the combined deviation is:

$$S_{pooled} = \sqrt{\frac{(SD_1)^2 + (SD_2)^2}{2}}$$

Information:
$(SD_1)^2$: variance score *pretets*
$(SD_2)^2$: variance score *posttest*

Table 1. 1Interpretation of Nilai Cohen's d

Cohen's d	Criterion
d ≥ 2,1	Very High
0,8 ≤ d ≤ 2,0	High
0,5 ≤ d ≤ 0,79	Medium
0,2 ≤ d ≤ 0,49	Low
0,0 ≤ d ≤ 0,19	Very Low

For the formulation of the second problem, namely to find outthe motivation for student achievement after being given learning with the PARAS learning model, it will be analyzed with the following formula Arwadi (2021):

$$X = \frac{total\ score}{number\ of\ students} \times 100$$

Table 2. Criteria for Motivational Achievement

Interval X	Category
≤ 39%	Very Low
40% - 54%	Low
55% - 69%	Medium
70% - 84%	High
85% - 100%	Very High

For the formulation of the third problem, namely to find out whether there is a relationship between the motivation to excel and the student's geometric thinking ability, data processing begins with grouping students based on the category of student achievement motivation. Furthermore, the data analysis technique uses contingency coefficients. Before calculating the contingency coefficient calculate the chi-square value first. The level of signification used is 5%.

RESULTS AND DISCUSSION

Descriptive data on the results of pretests and postes of students' geometric thinking skills are presented in the following table:

Table 3. Descriptive Data Ability to Think Geometry

	N	Min	Max	Average	SD	Var
Pretest	22	12	44	24.54	9.18	84.26
Postest	22	40	84	63.27	11.08	122.87

From Table 3, it is known that the average student's geometry thinking ability increases when viewed from the results of pretests and postes. This shows that the PARAS learning model has an influence on students' geometric thinking ability. The initial problem in this study was students who had not been able to reach the deduction level and the rigor level. For this reason, a table of student pretests and postes results will be presented based on the level of geometric thinking ability.

Table 4. Results of Pretes and Postes Reviewed from the Level of Geometry Thinking Ability

		Geometry Thinking Ability Level				
		0	1	2	3	4
Pretest	N	10	5	4	0	0
	%	45.45	22.73	18.18	0	0
Postest	N	20	17	15	11	0
	%	90.91	77.27	68.18	50	0

Table 4 shows that the application of the PARAS learning model is able to increase the level of students' geometric thinking ability to level 3, namely 50% of students have been able to reach the deduction level. However, it is still not able to reach level 5, namely 100% of students have not been able to reach the rigor level. There are many obstacles faced to improve the ability of students to the rigor level. One of them is that the time for students to habituate in solving evidentiary questions is still very lacking, namely only 6 meetings. According to Haviger & Vojkůvková (2015), students who are able to reach the rigor stage mean that they are able to use all kinds of evidence and are able to add or remove axioms when solving geometry problems. In this case, the meeting time of 6 times is not enough for students to master, understand, and use all types of proof when facing the problem of evidentiary geometry.

Furthermore, the results of the effect size test calculation will be displayed to determine the effectiveness of the PARAS learning model on students' geometry thinking ability.

Table 5. Effect Size Test Results (d)

Average		Standard Deviation (SD)		Spooled	d
Pre test	Pos test	Pre test	Pos test		
24.54	63.27	9.18	11.08	10.18	3.81

Based on Table 5, it is known that the cohen's d effect size (d) value of 3.81, which is > 2.1, which means that the magnitude of the influence of the PARAS learning model is classified as very high on students' geometric thinking ability. Although the previous analysis was known to have not reached the rigor level, students showed significant changes in results from before being treated with after being given learning. Facts on the ground show that students are consistent in following the learning process and solving the questions given enthusiastically. Students do not show boredom and compete to show their skills when asked to present to solve the problems given. According to previousresearch, it is known that the learning process that invites a person to solve problems effectively improves the thinking ability and encourages the person's creativity, moreover, it can improve the quality of teaching (Buckley et al., 2019; Jamaan et al., 2018; Simamora et al., 2017; Stupel & Ben-Chaim, 2017).

The results of the calculation of the student achievement motivation questionnaire are presented in Table 6 below.

Table 6. Results of the Achievement Motivation Questionnaire Based on Indicators

No	Indicators	Percentage	Category
1	Setting the standard of excellence	73%	High
2	Needs (motives)	79%	High
3	Probability (expectation) of success	68%	Medium
4	Incentive value (pride in achievements)	82%	High
Average		75.5%	High

Table 6 shows that the motivation for student achievement is relatively high on average. The learning process with the PARAS model is a modification of the ARCS model that focuses on giving and maintaining one's motivation during learning. So that the PARAS learning model also provides motivation that attracts students to be involved during the learning process. One of the components of the PARAS learning model is satisfaction , which causes a sense of satisfaction and pride in self-achievement. In other words, every meeting in the learning process will bring out a satisfaction component namely students are always given a sense of "pride in their achievements" so that their motivation for achievement is encouraged. It is important to always provide motivation to students during the learning process to bring out and maintain their motivation in class (Bhoke, 2018), (Hwang et al., 2020), and (Li & Keller, 2018).

The results of the analysis of the relationship between the motivation to excel and the student's geometric thinking ability are presented in Table 7. Previously, it was known that the grouping of students based on the motivation category of student achievement was classified as medium and high, then the grouping of students based on the level of geometry thinking ability, namely level 0, level 1, level 2, and level 3. From this grouping, a contingency of 2 x 4 will be used. Before calculating the contingency coefficient will be presented a table of chi-square calculation results.

Table 7. Chi-Square Test Calculation Results

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.077	3	0.758
Likelihood Ratio	1.518	3	0.714
Linear-by-Linear Association	0.421	1	0.545
Number of Valid Samples	22		

Table 7 shows the values *Chi-Square*$_{\text{count}}$ is 1,077 and known value *Chi-Square*$_{\text{table}}$ is 7,815. Because of the value of *Chi-Square*$_{count}$ < *Chi-Square*$_{\text{table}}$ and the probability 0,758 > 0,05 then H_o is accepted which means that there is no relationship between the motivation to excel and the student's geometric thinking ability. Furthermore, the results of the calculation of the contingency coefficient in Table 8.

Table 8. Contingency Coefficient Calculation Result

	Value	Approx Sig.
Contingency Coefficient	0.173	0.758
Number of Valid Samples	22	

Table 8 shows that the value of the contingency coefficient is only 0.758 which means that the relationship is classified as very weak. One of the reasons is the variation in the grouping of student achievement motivation is lacking, there are no students who are classified as low, only 5 students are classified as moderate and the rest are relatively high student achievement motivation. So it needs further analysis, this is also strengthened from the many studies that state that there is a relationship between the motivation to excel and a person's ability. One of them is Hwang et al. (2020) research, it is known that motivation has an influence on student learning behavior and directs behavior towards certain goals so that their thinking ability is better. Li & Keller (2018) also argues that any learning experience will not succeed without proper motivation for learners. Therefore, the role of motivation becomes very important, because motivation is a driver or impetus to carry out certain actions that further affect the thinking ability of students.

CONCLUSION

Based on the results of data analysis and discussion, it is concluded that the effectiveness of the PARAS learning model on students' geometric thinking ability is very high and students have been able to reach the deduction level. For the motivation for student achievement after being given learning with the PARAS learning model, it is concluded that the average is relatively high. Furthermore, it is known that there is no relationship between the motivation to excel and the student's geometric thinking ability and the contingency results show that the relationship is classified as very weak. The suggestion for further research is that the application of the PARAS learning model should be carried out in a long period of time at least one semester to get more accurate data in familiarizing students with evidentiary questions and especially motivating students to require a relatively long time.

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