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The Effect of Islamic Oriented Problem-Based Learning towards Spatial Ability and Self-Regulated Learning of Madrasah Aliyah Students

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Abstract This intervention study focused on: (1) analyzing whether there is a significant effect of islamic oriented problem based learning model towards student's mathematical spatial ability or not and (2) analyzing whether there is a significant effect of islamic oriented problem based learning model towards student's self regulated learning or not and (3) analyzing whether there is a significant interaction between learning model and prior mathematical ability towards student's mathematical spatial ability or not. (4) analyzing whether there is a significant interaction between learning model and prior mathematical ability towards student's self regulated learning or not. This study is a quasi experimental research that used mathematical spatial ability test and self regulated learning quisionaire. Population in this study are all students in MAS Nurul Hikmah Tinjowan Academic Year 2019/2020 and the samples are 32 students in class XII-1 IPS taught by using islamic oriented problem based learning model and 32 students in class XII-2 IPS taught by using convensional learning. The data was analyzed by using *t-test.* Hypothesis test used by Two Way Anova and found that: (1) there is a significant effect of islamic oriented problem based learning model towards student's mathematical spatial ability and (2) there is a significant effect of islamic oriented problem based learning model towards student's self-regulated learning (3) there is no a significant interaction between learning model and prior mathematical ability towards student's mathematical spatial ability. (4) there is no a significant interaction between learning model and prior mathematical ability towards student's self regulated learning.

Keywords: *mathematical spatial ability, self regulated learning, islamic oriented problem based learning*

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1. Introduction

Mathematics is one of the subjects that can equip students with competencies such as logical, analytical, systematic, critical, and creative thinking, as well as the ability to train. This competency is needed so that students can obtain, succeed, and obtain information to survive when it has to change, is uncertain and competitive [1].

The purpose of this learning will go through the process of learning mathematics. The learning process of mathematics discusses five content standards, namely the concepts and operations of numbers, measurements, geometry, algebra and analysis of data and opportunities [2].

Therefore, we need a learning method that can activate students, so they can support students to make it easier to facilitate spatial mathematics related to three-dimensional material, and increase students' knowledge of mathematics, as well as having skills in learning independence.

According to Zulfahmi, Syahputra & Fauzi [3] stated that; "The spatial ability of mathematics in students in Indonesia is very low".

The same thing according to Putri [4] states that the results of her research at SMP Negeri 2 Pulo Bandring results of spatial ability tests of students given in grade IX are still low. Based on the results of researchers 'discussions with mathematics teachers, students' spatial ability is still low and not in accordance with what is expected. It is suspected that there are several factors related to spatial ability among others, students do not need to involve themselves in learning because students assume math problems are difficult and cannot learn on their own, consequently students can wait for teacher's help. The individualistic nature and interests of students who are good at challenging learning in the classroom so that no student is actively involved in learning.

Fauzan (in Syarah) [5] states that the spatial ability supported by high school students in grade X in West Sumatra is still low. There are several things found in his research, namely students who focus on displays consisting of images, students need teaching aids related to the material being studied and students do not understand three-dimensional concepts. Some of the findings in Fauzan's research question students who have difficulty in studying space because students' abilities are still relatively low.

According to Noviani, Syahputra & Murad [6]: said that the concept of spatial thinking is quite interesting to discuss considering that many previous studies stated that children find many difficulties to understand objects or geometrical drawings.

The above agrees with Syahputra's research [7] that: "Good spatial ability will make students able to detect relationships and changes in geometric shapes". Syahputra [7] added "Such is the importance of spatial ability that we all, especially teachers, are required to give more than enough attention so that spatial ability is truly taught in accordance with the mandate of the curriculum".

This low mathematical spatial ability is also seen in the results of the analysis of the absorption of the National Exam subject matter of the third dimension which is still relatively low. It was found that students of SMA N 1 Banjarnegara in 2011 were 79.83%, for Banjarnegara Regency at 51.52%, for Central Java Province at 52.96% and for National at 64.78% [8]

Aspects that need to be considered in supporting students 'spatial abilities are by paying attention to the background of students' initial mathematical abilities. This is emphasized by Trianto [9] as follows: "often a student (student, student) has difficulty in understanding a particular knowledge which is one of the causes because the new knowledge received does not occur in relation to prior knowledge or perhaps prior knowledge has not yet been possessed. In this case, initial knowledge becomes the main requirement and becomes very important for students to have. "

The several components that can be used to measure learning independence are as follows: (1) learning initiatives; (2) diagnosing learning needs; (3) organizing and controlling learning progress; (4) regulating and controlling cognition, motivation and behavior in learning; (5) choosing and implementing learning strategies; (6) views adversity as a challenge; (7) evaluating the process and learning outcomes. [10]

The importance of student learning independence is not in accordance with the facts seen in the field. From the results of the questionnaire given by researchers to 32 students in class XII MAS Nurul Hikmah Tinjowan, it was concluded that: (1) 46.7% of students did not yet have learning initiatives; (2) 40% of students have not been able to diagnose their learning needs; (3) 66.7% of students have not been able to manage and control their learning, (4) 40% of students have not been able to use and find relevant resources; and (5) 56.7% of students have not been able to choose and implement their learning strategies.

From the opinion above, the thing that causes the low spatial ability and independence of student learning is the model and learning tools that are not suitable that are used by teachers to be able to explore the spatial ability and independence of learning in students. One of the learning models that will be applied to improve spatial ability and learning independence is the Problem Based Learning (PBL) model.

This is supported by the opinion of Yeni [11] who said that to overcome the difficulties of students in learning geometry, teacher's efforts are needed in using teaching methods and learning media that can meet the demands of student needs in learning in accordance with the stages of intellectual development.

In addition, according to Eviyanti, Surya & Syahputra [12] that learning with problem-based learning helps students to show and clarify ways of thinking and the rich structure and cognitive processes involved in it. PBL optimizes the goals, needs, motivations that drive the learning process to design various kinds of cognitive problem solving.

In PBL learning begins with the problem raised first. The objectives of the PBL Model are (a) developing high-level thinking skills; (b) learning to share the role of adults; and (c) becoming an autonomous and independent student. [13]. According to Wardhani [13] PBL follows three main schools of thought that developed in the twentieth century, namely:

a. John Dewey and his democratic class (1916), that schools should reflect a larger society and the class is a laboratory for solving real-life problems.
b. Jean Piaget (1886-1980), that children have an innate curiosity and are constantly trying to understand the world around them. Curiosity motivates children to actively build a display in their brains about the environment they live.
c. Lev Vygotsky (1896-1934) with his constructivist, that social interactions with other friends spur the formation of new ideas and enrich students' intellectual development. Jerome Brunner with his discovery learning, that the importance of discovery learning, namely a learning model that emphasizes the need to help students understand the structure or ideas of a scientific discipline, the need for students to be active in the learning process.

Arends [14] argues that there are five phases or stages in PBL syntax, namely: (1) Students' orientation to problems, (2) organizing students in learning, (3) guiding individual or group investigations; (4) develops and presents the work, and (5) analyzes and evaluates the problem solving process.

Because problem-based learning is applied to Islamic madrasa educational institutions, the most suitable learning model for researchers to develop is problem-oriented learning in Islam. This Learning Model is considered relevant to present a real atmosphere in the learning process including mathematics learning in Islamic madrasah educational institutions because contextually the learning problems in madrasas are particularly related to real life, especially those related to spatial ability in spatial problems, Islamic content such as dimension three. Learning approaches or models that are considered appropriate and appropriate in such learning are problem-oriented learning based on Islam.

If we look into the Qur'an, we will not be surprised what scientists say such as Galileo and Hawskin, because about 600 years before, the Qur'an had stated that everything was created mathematically. Like the word of God in the Qur'an Surah Al-Qamar verse 49 [15] follows:

Meaning: Indeed, we create everything according to size.

Everything in nature has a size, there are calculations, there is a formula, or there are similarities. Al-Qur'an is a source of knowledge. With that, it is hoped that one's moral and religious character will be formed so that the Qur'an is not neglected by worldly activities. A concrete example of the Qur'an as the source of all knowledge such

as mathematics. Mathematics in terms of its philosophy comes from the Qur'an.

2. Research Method

This research is categorized into quasi experimental research with a Non Equivalent Postest Only Control Group Design. This study involved two classes, the experimental class and the control class which were given different treatments. In quasi experimental research, the population cannot be ascertained homogeneous, in other words the population is heterogeneous. In the quasi experimental research, it is not also possible to control all external variables that influence the study

2.1. Population and Sample

This research will be conducted in MAS Nurul Hikmah Tinjowan which is located at Masjid Taqwa Street, Emplasmen Tinjowan, Ujung Padang District. Simalungun in class XII IPS. When the study was conducted in odd semester 2019/2020 school year.

The population in this study were all students of class XII IPS MAS Nurul Hikmah Tinjowan, Ujung Padang District, totaling 64 students in the 2019/2020 school year. The selection of MAS Nurul Hikmah Tinjowan's students was based on consideration of the level of student ability that made it possible to implement an Islamic-oriented Problem Based Learning Approach.

The sample in this study was chosen randomly (cluster random sampling) to be determined as an experimental group and a control group. The random selection stage is possible because it is based on information from school principals and teachers that the distribution of students in each class is heterogeneous.

2.2. Research Instrument and Data Analysis Technique

The data in this study was obtained from mathematical spatial ability test and self-regulating scale test. Data analysis consisted of normality test, homogeneity test, and hypothesis test. The statistical hypothesis test used is Two Way Anova. All statistical calculations used SPSS 22. The statistical model in this study is as follows:

The statistical model of this research experiment is as follows:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

where i = 1, 2, 3; j = 1, 2; k = 64.

with :

Y_{ijk} : Score dependent variable (mathematical spatial ability or self regulated learning)

μ : Average actual score (constant value)

αi : Effect of additives on the i-th PMA (high, medium and low)

βj : The additive effect of the jth learning

$(\alpha\beta)_{ij}$: Interaction between students' learning and mathematical initial abilities [16].

2.3. Research Procedure

The steps taken in this experimental research are as follows:

First step, pre experimental measurement. Before giving the treatment, the experimental and control class students were given a prior mathematical ability (PMA) test in the form of multiple choice. There were 20 questions taken from the Junior High School National Examination. The student's PMA test can be seen from two values, they are the mathematics scores in the previous semester and the test scores. The PMA test aims to determine the level of student ability before being treated whether the prior ability is high, medium, or low.

Second step, treatment. After the two groups were given a prior mathematical ability test, the next step was to provide treatment. Treatment in the experimental class was the application of problem based learning model based on Islamic, while the control class applied an conventional learning model. Treatment will be carried out each time 4 meetings or 8 hours of study. Each class is held in 2 x 45 minutes each time. [17]

In this experimental research carried out by going through several stages beginning with a preliminary study that is used to formulate the identification of problems, the formulation of the problem of literature studies that ultimately obtained research tools in the form of student worksheets, learning tools and research instruments. The research tools that have been compiled are firstly validated by competent experts [18]. Furthermore, the control class and the experimental class first do an initial ability test with the aim of whether both groups have homogeneous abilities and place students in the high, medium and low groups according to their mathematical abilities before the research action is carried out.

3. Research Results

3.1. Student's Prior Mathematical Ability Description

To obtain an overview of student's PMA, the average and standard deviation (SD) were calculated. The calculation results are presented in Table 1 below.

Table 1. Student's Prior Mathematical Ability Description

Class	Ideal Score	N	Xmin	Xmax	$\bar{x}$	SD
Experimental Class	100	32	40	95	64,69	16,65
Control Class	100	32	20	90	55,63	18,74

The grouping of student's prior mathematical ability (high, medium, and low) was formed based on the student's PMA scores. For students who have PMA score $\geq \bar{x}$ + SD were grouped in high ability, students who have PMA score between less than $\bar{x}$ + SD and more than $\bar{x}$ - SD were grouped in medium ability, while students who have PMA score $\leq \bar{x}$ - SD were grouped in low ability. The summary results are presented in Table 2 below.

Table 2. Research Sample Distribution

Class	Student's Ability		
	High	Medium	Low
Experimental Class	7	20	5
Control Class	4	19	9
Total	11	39	14

Based on Table 2 above, it was found that in the experimental class taught by islamic oriented problem based learning model there were 7 high ability students, 20 medium ability students, and 5 low ability students. Whereas in the control class taught by convensional learning there were 4 high ability students, 19 medium ability students, and 9 low ability students.

3.2. Student's Mathematical Spatial Ability Description

Mathematical spatial ability tests are essay questions related to the material being experimented, namely the three dimensional material. Test consists of four questions representing four indicators of mathematical spatial ability, namely: spatial perception, visualization, mental rotation, spatial relations and spatial orientation. Posttest data processing and analysis aims to determine student's spatial ability after being taught by Islamic oriented problem based learning models in the experimental class and student's mathematical spatial ability after being taught by conventional learning models in the control class. The results of the posttest for the two classes are described in Table 3 below.

Table 3. Student's Mathematical Spatisl Ability Description

Class	Ideal Score	N	X_{min}	X_{max}	$\bar{x}$	SD
Experimental Class	100	32	40	90	71,68	16,38
Control Class		32	35	83	63,25	13,85

Based on Table 3 above, it showed that the minimum posttest score of student's spatial ability in the experimental class was 40 and higher than the students in the control class whose minimum score was 35. For the maximum score of student's mathematical spatial ability in the experimental class was 90 and higher than the students in control class whose maximum score is 83. Furthermore, the average posttest score of student's mathematical spatial ability for the experimental class was 71,68 and higher than the students in the control class whose average score was 63,25. The standard deviation of posttest data on student's spatial ability for the experimental class is 16,38 and 13,85 for the control class.

The description of student's posttest spatial ability based on the student's prior mathematical ability (PMA) can be seen in Table 4 below

Table 4. Posttest Spatial Ability Description Based on Student's Prior Mathematical Ability (PMA)

Class	PMA	N	Average Score
Experimental Class	High	7	90
	Medium	20	72,25
	Low	5	43,80
Control Class	High	8	80,75
	Medium	17	63,82
	Low	7	43,29

Research results showed that there is a significant effect of islamic oriented problem based learning model towards student's mathematical spatial ability. It can be seen in Table 5 below.

Table 5. Two Way Anova Test Result of Spatial Ability

Tests of Between-Subjects Effects					
Dependent Variable: K_Spasial					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12541,051[a]	5	2508,210	52,218	,000
Intercept	215644,667	1	215644,667	4489,454	,000
PMA	11477,235	2	5738,618	119,471	,000
Learning	459,884	1	459,884	9,574	,003
PMA * Learning	159,862	2	79,931	1,664	,198
Error	2785,949	58	48,034		
Total	308008,000	64			
Corrected Total	15327,000	63			
a. R Squared = ,818 (Adjusted R Squared = ,803)					

Based on the results of the Two Way Anova test in Table 5 above, the significance value for learning is 0,003 which is smaller than the significance 0,05 or sig. < 0,05 (0,003 < 0,05), it means that H_0 rejected. It can conluded that there is a significant effect of problem based learning model based on Islamic towards student's mathematical spatial ability. In other words, the effect of islamic orienteds problem based learning model on student's mathematical spatial ability is better than convensional learning on student's mathematical spatial ability.

Furthermore, the results of the Two Way Anova test show that the significance value for PMA*Learning is 0,198 which is greater than the significance 0,05 or sig. > 0,05 (0,198 > 0,05), it means that H_0 accepted because there is not enough evidence to reject H_0. In other words, there is no influence given by the learning model with student's PMA on student's mathematical spatial ability. Differences in student's mathematical spatial ability are caused by differences in learning that are applied not because of the student's prior mathematical ability. So it can be concluded that there is no significant interaction between learning model and PMA towards student's mathematical spatial ability.

Graphically, the interaction between learning model and PMA towards student's mathematical spatial ability can be seen in Figure 1 below.

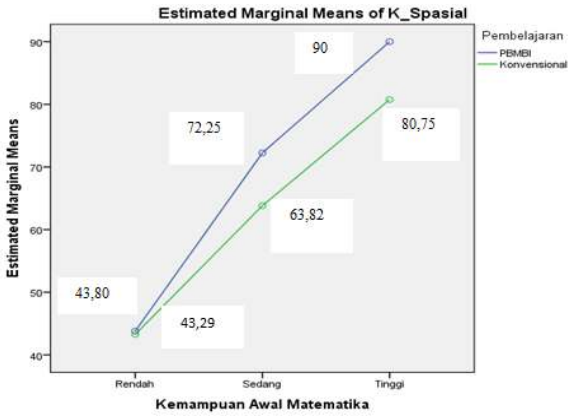

Figure 1. Graphic Scatter Plot The Interaction Between Learning Model and PMA Towards Student's Mathematical Spatial Ability

Based on Figure 1 above, it can be concluded that there is no a significant interaction between learning model and prior mathematical ability towards student's mathematical spatial ability.

3.3. Student's Mathematical Learning Self Regulated Description

Self-Regulated Learning Tests are questions related to the material being experimented, namely the three-dimensional material. Tests consisting of thirty questions represent eight indicators of self-regulated learning, namely: self evaluating, organization and information, goal setting and planning, information seeking, environmental structuring, reshing and memory, seek per, teacher, adult assistance, review test / work. Posttest data processing and analysis aims to determine student's self-regulated learning after being taught by Islamic oriented problem based learning models in the experimental class and student's self-regulated learning after being taught by conventional learning models in the control class. The results of the posttest for the two classes are described in Table 6 below.

Table 6. Student's Mathematical Self Regulated Learning Description

Class	Ideal Score	N	X_{min}	X_{max}	$\bar{x}$	SD
Experimental Class	4	32	1	4,37	3,25	1,008
Control Class		32	1	4,37	3,25	1,008

Based on Table 6 above, it showed that the minimum posttest score of student's self-regulated in the experimental class was 1 and same with the students in the control class whose minimum score was 1. For the maximum score of student's self-regulated learning in the experimental class was 4,37 and same with the students in control class whose maximum score is 4,37. Furthermore, the average posttest score of student's self-regulated learning for the experimental class was 3,25 same with the students in the control class whose average score was 3,25. The standard deviation of posttest data on student's self-regulated learning for the experimental class is 1,008 and 1,008 for the control class.

The description of student's posttest self-regulated learning based on the student's prior mathematical ability (PMA) can be seen in Table 7 below.

Table 7. Posttest Self-Regulated Learning Description Based on Student's Prior Mathematical Ability (PMA)

Class	PMA	N	Average Score
Experimental Class	High	11	4,50
	Medium	15	3,48
	Low	6	2,24
Control Class	High	8	4,34
	Medium	14	3,19
	Low	10	1,99

Further research results showed that there is a significant effect of Islamic oriented problem based learning models towards student's self regulated learning. It can be seen in Table 8 below.

Table 8. Two Way Anova Test Result of Self Regulated Learning

Tests of Between-Subjects Effects					
Dependent Variable: Self-Regulated Learning					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	46,060[a]	5	9,212	31,380	,000
Intercept	629,165	1	629,165	2143,247	,000
KAM	44,613	2	22,307	75,988	,000
Learning	,814	1	,814	2,773	,010
KAM * Learning	,044	2	,022	,075	,928
Error	17,026	58	,294		
Total	739,411	64			
Corrected Total	63,086	63			
R Squared = ,730 (Adjusted R Squared = ,707)					

Based on the results of the Two Way Anova test in Table 8 above, the significance value for learning is 0,01 which is smaller than the significance 0,05 or sig. < 0,05 (0,01 < 0,05), it means that H_0 rejected. It can conluded that there is a significant effect of islamic oriented problem based learning model towards student's self regulated learning. In other words, the effect of islamic oriented problem based learning model on student's self regulated learning is better than convensional learning on student's self regulated learning.

Furthermore, the results of the Two Way Anova test show that the significance value for PMA*Learning is 0,928 which is greater than the significance 0,05 or sig. > 0,05 (0,928 > 0,05), it means that H_0 accepted because there is not enough evidence to reject H_0. In other words, there is no influence given by the learning model with student's PMA on student's sel regulated learning. Differences in student's self regulated learning are caused by differences in learning that are applied not because of the student's prior mathematical ability. So it can be concluded that there is no significant interaction between learning model and PMA towards student's self regulated learning. Graphically, the interaction between learning model and PMA towards student's self regulated learning can be seen in Figure 2 below.

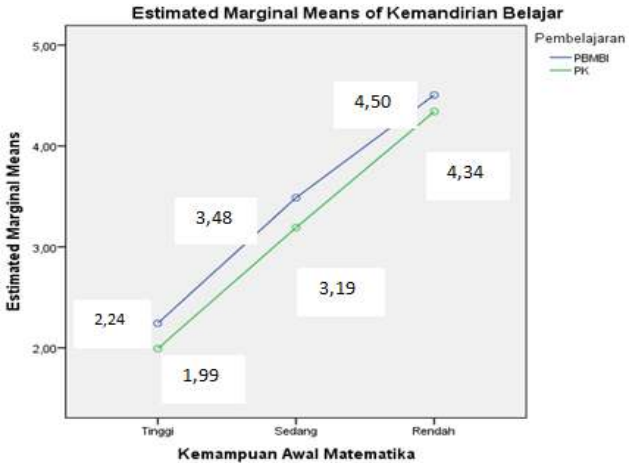

Figure 2. Graphic Scatter Plot The Interaction Between Learning Model and PMA Towards Student's Self Regulated Learning

Based on Figure 2 above, it can be concluded that there is no a significant interaction between learning model and

prior mathematical ability towards student's self regulated learning

4. Discussion

Based on the results of the study, the average spatial ability score of students taught with Islamic-oriented problem-based learning is better than the average spatial ability score of students taught with ordinary learning. To answer it all in the formulation of the problem, researchers must analyze all data from the field. Furthermore, to provide positive input for improvement if applying Islamic-oriented problem-based learning, it is necessary to put forward things that can overcome the problems found in a study to measure the spatial abilities and attitudes of student learning independence.

Based on interviews with several students, there are some things that still become obstacles of ongoing learning including (1) less time spent in learning (2) ability to understand questions especially the spatial part of perception and mental rotation (3) students who don't care and serious in working on the problems.

In the control class the learning system is centered on the teacher, with the learning model used a direct learning model. In the control class students are less actively involved in the learning process compared to the experimental class taught using the PBL model. The lack of active students in the learning process causes the students' spatial thinking skills to be poorly trained, this can be seen in the average value of the experimental class that is = 71.68 which is far better than the average value in the control class that is = 63.56 A person thinks spatial must be able to see and give the decisions they make, must be able to answer the question why such decisions are made [19], this is seen in students in the discussion phase. In the experimental class the researcher only directs students to the problems that have been selected then students do the process of solving the problem independently. When solving problems, students' thinking is optimized through group work processes by means of students gathering information relating to problems from student and LKPD handbooks.

5. Conclusion

Based on the results of the analysis and discussion that have been described in the previous section, it could be concluded as follows:

1. There is a significant effect of islamic oriented problem based learning towards student's mathematical spatial ability.
2. There is a significant effect of islamic oriented problem based learning towards student's self-regulated learning
3. There is no a significant interaction between learning model and prior mathematical ability towards student's mathematical spatial ability.
4. There is no a significant interaction between learning model and prior mathematical ability towards student's self-regulated learning.

6. Suggestions

There are a number of things that we must strengthen and improve so that this research is truly needed and contributes to all parties as follows:

1. Mathematics learning with Islamic-oriented problem-based learning approach can be expanded to use, not only in the three dimensional material but also in other mathematics subject matter. It is suggested to the teacher to create a learning atmosphere that gives students the opportunity to express mathematical ideas in their own language and ways, so students become bold in their arguments, confident and creative.
2. Islamic-oriented problem-based learning approach by emphasizing the spatial ability and independence of student learning towards mathematics is still very foreign to teachers and students, therefore it needs to be socialized by schools or related institutions, with the hope of increasing spatial ability and learning independence towards mathematics.
3. For further research this research should be complemented by including a variety of different factors, such as students 'attitudes and learning interests, students' economic backgrounds, and so on. So that research on spatial ability and student learning independence is not solely influenced by the learning approach.
4. For further researchers to pay more attention and focus on where the weaknesses of students' spatial abilities, especially the parts of spatial perception and mental rotation that still has a lot of wrong solutions and low grades.

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