The enhancement of spatial levels reviewed from students’ cognitive styles

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Abstract: Space ability can be interpreted with the ability of spatial. The Great Indonesian Dictionary mentions that spatial is anything related to space or place. It can be interpreted that the students' spatial ability demands their ability to understand the visualization of abstract objects or objects in the minds of students. This spatial capability itself will require the mastery of its geometric capabilities. Students' geometry ability mastery can be supported by the improvement of his cognitive style of how to receive, organize, process information and then organize them based on their experiences relating to how they think and solve the problems. The purpose of this study was to examine the differences in spatial ability among students with the cognitive style of Field Independent with Field Dependent on learning Anchored Instruction. Population of this research was all students of class X IPA SMA Negeri 1 Takengon Regency of Central Aceh in the academic year 2016/2017. The samples of the research were 2 classes; those were X IPA 1 and X IPA 2, with the number of students was 30 for each class determined by purposive sampling. Data analysis was done by using descriptively quantitative. To know the difference of mean was by using t test of two samples. From the calculation results, it was concluded that there was no difference of spatial ability between students with cognitive style of Field Independent with Field Dependent, there was no difference of spatial ability between students with cognitive style Field Independent in class X IPA 1 with cognitive style Field Independent on learning Expository X IPA 2, There was no difference of spatial ability between students with cognitive style of Field Dependent in class X IPA 1 with cognitive style of Field Dependent in class X IPA 2.

1. Introduction

The efforts to improve the quality of education generally and in mathematics learning particularly to be the subject of study and priority for educational researchers. This study material is not only limited to thinking ability but also develops in various psychological aspects which also influence the students' skill in understanding mathematics. Mathematics as part of the curriculum plays a very important role in improving the quality of graduates who are able to act logically, rationally, critically, systematically in solving the problems of daily life or in the study of other sciences. Therefore, the ability of mathematical thinking becomes an interesting factor as a study of research conducted by educational researchers.

Kurikulum Tingkat Satuan Pendidikan (KTSP) states that after learning the students must have a set of mathematical competencies that must be demonstrated in the learning outcomes of the mathematics course. The mathematical skills are expected to be achieved by students in learning mathematics since elementary, junior to senior high school, ied est: 1) understanding of concepts, 2)
reasoning; 3) communicating; 4) problem solving; 5) and having an attitude of appreciating the usefulness of mathematics in life [1]. This is the reason why the subjects of mathematics are given to all students from elementary school to higher education level.

NCTM has defined 5 standards of content in mathematical standards, namely numbers and operations, problem solving, geometry, measurement, opportunity and data analysis. Furthermore, NCTM also describes four geometric capabilities that students must possess in studying geometry: (1) Being able to analyze the character and nature of both two dimensional and three dimensional geometry forms, and be able to construct mathematical arguments about the relationship of geometry with others; (2) Be able to determine the position of a point with a more specific and spatial relationship picture using geometric coordinates and connect them with other systems; (3) Application of transformation and use it symmetrically to analyze mathematical situations; (4) Using visualization, spatial reasoning, and geometry models to solve problems [2].

From 5 content standards determined by NCTM shows that students’ geometry mastery becomes more complex, it is not only limited to the calculation. Other geometry capabilities such as the use of visualization, spatial reasoning and modeling also serve as the basis for students to study geometry. But in reality there are students who still have difficulty in understanding geometry. One of the factors that cause these difficulties is because of the material characteristics which require visualization of abstract objects. Prabowo mentions that the problems in the field related to geometry in the school is due to the high degree of abstract object of geometry as well as the lack of visualization ability of abstract object or object in the students’ mind which is one of the elements of the viewing ability of the space that must be possessed by the students [4].

Several studies have been conducted to test the spatial abilities of students found significant difficulties on how to visualize geometry objects so that the impact on students' mathematical spatial ability is still weak. Teacher participation in geometry learning at school is required to train and develop students' mathematical spatial abilities. This is in accordance with Nemeth which states that spatial visualization is not found genetically but as a result of a long learning process [3].

One of the reasons why spatial ability of students in learning mathematics is low is influenced by the dominance of teacher activity in learning activities. According to Wahyudin among the causes of low achievement of students in math lesson is a less optimal learning process, where teachers are more active as the source of information, while students only serve as a recipient of the information. As a result, in solving the problems, students just follow what had been done by the teacher, so that students be lack of the ability to solve problems with other alternatives due to lack of flexibility capability which is the main component of his thinking ability [6]. This indicates that students’ spatial ability has not developed.

Besides, there are psychological aspects that contribute to improving the success of learners in understanding mathematics well. The psychological aspect is the cognitive style. Cognitive style is closely related to students’ learning environment. The cognitive style of the student will influence the way he receives, organizes, processes information and organizes them based on his experiences relating to how he thinks, solves problems and learns. In Geometry materials, for example, the characteristics of the material include the visual relationship (the ability to observe the relationship of the position of objects in space), the projective relationship (the ability to see objects from various points of view) will require good cognitive style so that students' spatial mastery becomes better.

2. Method
This research used quantitative research approach, with quasi experiment research method. The design in this study required two classes with different learning models. The research design used was pretest posttest control group design, Sugiyono which can be described in the following table:
Table 1. Research Design

| Pretest | Treatment | Postest |
|---------|-----------|---------|
| O₁      | X         | O₂      |
| O₂      |           | O₂      |

Note: O₁ : Pretest  
O₂ : Postes  
X : Learning Treatment [5]

This research was conducted in SMA Negeri 1 Takengon, Central Aceh Regency, in the odd semester of academic year 2016/2017. The population was all students of class X IPA. The sample was determined by purposive sampling technique. Furthermore, the samples of this study were 2 classes, namely class X IPA 1 and X IPA 2, with the number of students was 30 for each class. Instruments used in this study were: (1) Test of spatial ability, (2) Test of cognitive style.

3. Results and discussion

This study aimed to determine the spatial ability of students through the views of cognitive style. The data analyzed included the data of students' spatial ability test result and the data of students' cognitive style test result.

Table 2. Test Result of the Difference of Two Means of Students’ Spatial Ability from Cognitive Style

| t-test for Equality of Means | 95% Confidence Interval of the Difference |
|-----------------------------|----------------------------------------|
| T                            | df          | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Equal variances assumed      | 1,639       | ,121            | 1,200           | ,732                  |
| Equal variances not assumed  | 1,713       | ,106            | 1,200           | ,701                  |

The conclusion obtained from the hypothesis test above was that there was no difference of spatial ability between students with cognitive style of Field Independent with Field Dependent.

Table 3. Test Result of the Difference of Two Means of Students’ Cognitive Style FI Spatial Ability

| t-test for Equality of Means | 95% Confidence Interval of the Difference |
|-----------------------------|----------------------------------------|
| T                            | df          | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Equal variances assumed      | 2,080       | ,053            | 1,589           | ,764                  |
| Equal variances not assumed  | 2,096       | ,051            | 1,589           | ,758                  |

Result of test difference of two mean of spatial ability of student of cognitive style of field independent of class X IPA 1 and class X IPA 2 as seen in table above known that significance value equal to 0,053 > α = 0,05. This result concluded that there was no difference between the mean of spatial ability of the cognitive field-independent students in the field after learning in class X IPA 1 and the mean of students’ spatial ability of the cognitive field-independent after the learning in class X IPA 2.
Table 4. Test Result of the Difference of Two Means of Students’ Spatial Ability of Cognitive Style
FD

| T       | df |Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|---------|----|----------------|-----------------|-----------------------|------------------------------------------|
| Skor Spasial FD | Equal variances assumed | 1.655 | 14 | .120 | 1.125 | .680 | -.333 | 2.583 |
|          | Equal variances not assumed | 1.655 | 13,314 | .121 | 1.125 | .680 | -.340 | 2.590 |

Test result of difference of two means of students’ spatial ability of cognitive style of field dependent class X IPA 1 and class X IPA 2 as seen in table above known that significance value equal to 0.120 > α = 0.05. This result concluded that there was no difference between the mean spatial ability of the cognitive-dependent field-dependent students after the learning in class X IPA 1 and the mean of students’ spatial ability of the cognitive field-dependent after the learning in class X IPA 2.

Table 5. Test Result of the Difference of Two N-Gain Means of Students’ Spatial Ability of Cognitive Style FI

| T       | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|---------|----|----------------|-----------------|-----------------------|------------------------------------------|
| Skor N-gain FI | Equal variances assumed | 1.381 | 17 | .185 | .09122 | .06604 | -.04812 | .23056 |
|          | Equal variances not assumed | 1.398 | 16,825 | .180 | .09122 | .06527 | -.04660 | .22904 |

The result of difference test of two n-gain mean of spatial ability of students’ cognitive-style of independent field of class X IPA 1 and class X IPA 2 as seen in the above table note that the significance value of 0.185 > α = 0.05. This result concluded that there was no difference between the n-gain mean spatial ability of the cognitive field-independent student field after the learning in class X IPA 1 and the n-gain mean of students’ spatial ability of the cognitive-independent field after the learning in class X IPA 2.

Table 6. Test Result of the Difference of Two N-Gain Means of Students’ Spatial Ability of Cognitive Style FD

| T       | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|---------|----|----------------|-----------------|-----------------------|------------------------------------------|
| Skor N-gain FD | Equal variances assumed | 2.143 | 14 | .051 | 1.2625 | .05892 | -.00013 | .25263 |
|          | Equal variances not assumed | 2.143 | 9,872 | .058 | 1.2625 | .05892 | -.00527 | .25777 |

The test result of difference of two n-gain mean of spatial ability of students’ cognitive style of field dependent class X IPA 1 and class X IPA 2 as seen in table above known that significance value was equal to 0.120 > α = 0.05. This result concluded that there was no difference between the n-gain mean of spatial ability of the cognitive-dependent field-dependent students after the learning in class X
IPA 1 and the n-gain mean of students’ spatial ability of the cognitive field-dependent after the lesson in class X IPA 2.

The results of the research have shown that the spatial ability of students is not determined by the type of cognitive style. In class X IPA 1 students' spatial ability did not differ significantly when viewed from the cognitive style of field independent and field dependent. Similar results were obtained against the comparison of independent field cognitive styles on the comparison of two classes with different learning models and field dependent on the comparison of two classes with different learning models.

4. Discussion and conclusion
Based on the results of data collection and analysis in this study, the researchers took some discussion and conclusions as follow:

4.1 Discussion
1. For everyone who will apply the anchored instruction learning, he should notice the time effectiveness since in the application of the learning itself is not appropriate with what had been planned.
2. In anchored instruction learning, students are forced to construct their own abilities and knowledge through the learning material or the assignment given. Due to the reason, teachers should prepare and design as good as possible the assignment or activity in the learning material or students' worksheet.
3. Anchored instruction can be used for the different cognitive styles.

4.2 Conclusions
1. There was no difference of spatial ability between students with cognitive style of Field Independent with Field Dependent in student of class X IPA
2. There was no difference in spatial ability between students with cognitive style of Field Independent in class X IPA 1 with Field Independent cognitive style on X IPA
3. There is no difference in spatial ability between students with cognitive style of Field Dependent in class X IPA 1 with cognitive style of Field Dependent in class X IPA 2.
4. There was no difference in n-gain spatial ability between students with cognitive style of Field Independent in class X IPA 1 with Field Independent cognitive style on X IPA 2.
5. There was no difference of n-gain spatial ability between students with cognitive style of Field Dependent in class X IPA 1 with cognitive style of Field Dependent in class X IPA 2.

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