

The Influence of Students' Inquiry Learning and Spatial Ability Toward Molecular Shape Topic

Nur Sa'adah¹⁾, Effendy²⁾, Suhadi Ibnu²⁾

¹⁾SMAN 1 Situbondo

²⁾Chemistry Education–Universitas Negeri Malang

Jl. Pb. Sudirman 5a Situbondo . E-mail: n.saadahkim@yahoo.co.id

Abstract: The purpose of this study are (1) to know the differences of learning achievement on the molecular shape subject between the students who taught by inquiry learning and verification (2) to know the differences between the high spatial ability to the students learning achievement in the molecular shape topic (3) to know the interaction between the inquiry learning and verification teaching with the students' spatial ability. The results showed that (1) there were differences in learning achievement of students who were taught by inquiry learning and verification. The students' learning achievement of students who were taught by inquiry learning better than students who were taught by verification (2) there were differences between in learning outcomes of students with high spatial and students with low spatial, students who have high spatial performance is better than low spatial ability students the high spatial ability to the students learning achievement in the molecular shape topic (3) there were no interaction between inquiry learning and verification methods with the students' spatial ability.

Key Words: inquiry learning, visibility space, learning achievement

Abstrak: Tujuan dari penelitian ini adalah (1) mengetahui apakah ada perbedaan hasil belajar pada pokok bahasan bentuk molekul antara siswa yang diajar dengan pendekatan inkuiri terbimbing dan pendekatan verifikasi (2) mengetahui apakah terdapat perbedaan antara kemampuan kemampuan pandang ruang tinggi dan rendah terhadap hasil belajar siswa (3). mengetahui apakah terdapat interaksi antara cara pengajaran Inkuiri terbimbing dan verifikasi dengan kemampuan pandang ruang siswa.. Hasil penelitian menunjukkan bahwa (1) ada perbedaan hasil belajar siswa yang diajar dengan cara inkuiri terbimbing dan verifikasi. Hasil belajar siswa yang diajar dengan cara inkuiri terbimbing lebih baik dibanding dengan siswa yang diajar dengan cara verifikasi (2) ada perbedaan kemampuan pandang ruang tinggi dan rendah terhadap prestasi belajar kimia pada bentuk molekul, hasil belajar kimia dipengaruhi oleh kemampuan pandang ruang siswa (3) tidak ada interaksi antara metode pembelajaran inkuiri terbimbing dan verifikasi dengan kemampuan pandang ruang siswa.

Kata kunci: pendekatan inkuiri terbimbing, kemampuan pandang ruang, hasil belajar

There is a kind of research object in chemistry is the simple molecular shape. According to Effendy (2010), molecular shape of chemical compounds is discovered from experimental facts which are gotten using diffraction method, especially diffraction of X-rays, or gotten using spectroscopy method of infra red. From molecular shape that is discovered will going to draw theory to explain why its molecular adopts certain shape. Another theory which can explain the theory of molecular shape well is a theory of refusal pair of electron valence (VSEPR). The accuracy of prediction using VSEPR

theory is really high, especially for molecular which has a center of atom Nonmetal.

Theory of VSEPR is considered as an easy theory to be learned by learners from senior high school up to university level. Even though, some research reports there are still many students feel difficulty in learning molecular shape.

MacKinnon (1996) reported that from 302 students, 22% can determine the shape of NH_3 correctly which is a trigonal pyramid, while 78% students who can state the shape of NH_3 is trigonal planar. Habiba (2008) reported that 56,1% students still feel difficult

to draw the molecular shape. Sumarni (2010) in his research toward college students majoring chemical teaching at Universitas Negeri Semarang reported that 74,2% students feel misconception in drawing molecular shape based on the number of electron pair around the center of the atom. The majority of them understand pyramid shape as a triangle, tetrahedral as square and trigonal bipyramid as Rectangular and still there are some others.

Molecular shape topic is abstract, the understanding molecular shape is needed for visual spatial. This visual spatial is related with thinking ability through imagination and visualization. Visual-spatial intelligence is also the ability of visibility space because this intelligence focusing on students ability to visualize the structure in three dimensions (3D). The ability of visibility space having an important role in order to help students use their imagination in understanding an abstract concept.

During this molecular shape, the topic is discussed in SMAN 1 Situbondo, the students are going to be given an explanation of molecular shapes based on the theory of electron domain, using pictures of molecular shape and model of simple molecular shape. In fact, the result of this approach does not significantly improve the result of learning. There still many students get difficulties in understanding molecular shape. According to the explanation above, students need to be given an effective alternative approach for an abstract topic such as molecular shape based on the students' ability of visibility space which students in SMA 1 Situbondo can understand the topic well.

From the explanation above, it can be concluded that to teach molecular shape maximally by exploring the spatial ability of students. Another approach of teaching is constructivism where the students build their own ability. Another approach is an inquiry in which a set of learning steps is emphasizing the process critical thinking and analytical in order to find the an-

swer to the problem which is questioned (Sanjaya, 2008).

Learning process using inquiry approach is chosen in this research because this teaching approach has significant influence toward students. The choice of inquiry approach is based on the result of some research result that explained inquiry approach more effective to increase students' learning outcomes. Refer to Steiner, during the process of finding the concept or principle without direct experiment, students will directly analyse datum which is given by teacher, as the result of inquiry approach on VSEPR topic doesn't need to prove for molecular shape, it will only end in understanding the concept VSEPR, it is resulted in the steps in inquiry approach using the steps which are stated by Hanson (2005), which are orientation, exploration, drawing concept, application and conclusion.

Based on the explanation above, the purposes of this research are 1) to know whether there are differences in learning outcomes on the subject of molecular shape between students taught with guided inquiry approach and verification approach 2) Whether there are differences in learning outcomes between students with high and low space visibility 3) whether there is interaction which is influential between teaching approach with the ability of visibility space on students' learning outcomes.

METHOD

This research is using the design of factorial 2 x 2. The design of this study concerns the existence of moderator variables that affect the treatment variables (independent variables) on the results (Dependent variables). Design factorial 2x2 shown in Table 1.

Variable in this research consists of 2 independent variables which are inquiry and verification approach, dependent variables which are the ability of visibility

Table 1. Design Factorial 2 x 2"

Variabel moderator	Independent Variabel	
	Inquiry Approach (Y ₁)	Verification Approach (Y ₂)
High Spatial Ability (X ₁)	X ₁ Y ₁	X ₁ Y ₂
Low Spatial Ability (X ₂)	X ₂ Y ₁	X ₂ Y ₂

Description :

X₁Y₁ = Student learning outcomes who have spatial ability

X₁Y₂ = Student learning outcomes that have high spatial ability with application of learning verification approach

X₂Y₁ = The learning outcomes of students with low spatial ability with inquiry implementation

X₂Y₂ = Student learning outcomes that have low viewing ability with application of learning verification

space and dependent variable which is learning outcomes.

The population of this study is all students of SMA Negeri 1 Situbondo grade X consisting of 10 classes with a total of 297 students.

The sample of this research is grade X-8 consists of 29 students and X-10 consists of 29 students. The sampling technique is carried out by taking the subject of research, it is not based on strata, random or area but based on a particular purpose (Arikunto, 2006, p. 140). The reason for using this technique is because of the limitation of time and class which has been arranged based on school's consideration and should not be randomized.

The instruments used in this study are the measurement of cognitive learning outcomes and instruments of students' field vision. The instrument used in the form of multiple choice test (multiple choice) consists of 35 test items. For each test, the item is given 5 possible answers with one alternative answer right choice. For correct answer given score 1, while for the wrong answer given score 0.

After the instrument has been made, the content of instrument will be validated by experts which are two chemical lecturers at Universitas Negeri Malang and one chemical teacher of SMA Negeri 1 Situbondo. These validators are given instrument grating sheets, question sheets, and instrument validity sheets. The instrument validity sheet contains columns for assessing the communicative matter and suitability of the material and required to provide a note of improvement as necessary. Scoring techniques follow some rules, namely (a) score 1 if the problem is not in accordance with indicators and language is not communicative; (b) score 2 if the problem matches the indicator but the language used is less communicative; (c) score 3 if the materials are in accordance with indicator and language communicative. Then, the scores given by the validator are expressed in percentage by using the following formula.

$$P_n = \frac{\sum \text{Score}_n}{\sum \text{Total of test}} \times 100\%$$

Test reliability indicates that the instrument used can be trusted to be used as a data collection tool because the instrument is already well expected to obtain the same learning outcomes (Arikunto, 2006, p. 178). In this study, the reliability of the molecular form test instrument was calculated using Cronbach's SPSS 17 model for Windows. From the calculation results obtained reliability coefficient value 0.83. from table *r_{product}*

moment is indicated using $N = 30$, price $r_{\text{table}} = 0,36$. because $r_{\alpha} > 0,36$, the instrument of research in this study is categorized reliable.

The instrument used to measure the spatial ability is the ability of students to recognize an object/image with precisely, in the context of spatial. This instrument is derived from the UM Psychology Center Institute, the researcher asks for help to test the student's spatial. The variable of the spatial ability of space can not be manipulated so that the researcher only grouped based on high and low spatial ability level. Spatial capability tests consist of ISEL (Intelligence-Structure-Test) and TPA (Academic Potential Test) tests. IST is a test developed by Rudolf Amthauer in Frankfurt, Germany, in 1953. In Indonesia was developed by the Persona Bandung Psychology Bureau after being modified. The IST test in this study used consisted of choosing form (FA). In this subtest, students measure the ability to construct (synthesis and analysis), imagine, insert a part of a whole as well as concrete thinking thoroughly. The second subtest is a beam exercise (WU). In this subtest thing to be measured are three-dimensional capability, space shadow power, technical constructive ability, and analytical ability.

In this test used is the test of space field skills, including image matching test, image series test, image categorization test, image shadow test, and image identification test. The variable of visibility of space can not be manipulated so that the researcher only grouped based on high and low spatial ability level. Reliability of the test of view of space for men has a reliability coefficient of 0.81 to 0.86, while for women the reliability coefficient of this test 0.69 to 0.73. Appropriate Criteria of Reliability Grain Problem, the reliability of the problem for men is very high, while for women is high.

The main steps in the research that have been done are as follows; preparing the research instrument, performing the validity and reliability test of the instrument, determining the research subject, arranging the schedule of the research implementation, carrying out the test of spatial ability (using PC UM), applying the inquiry approach for the students' experimental group and verification approach for controlling group. Also, collecting data with written test, performing data analysis from the test result.

The data is the students' visibility space and student learning outcomes after given treatment. Before the data of students' visibility space and learning outcomes datum are analyzed. There will be conducted normality test and homogeneity test which are con-

ducted to determine whether the data can be used as the basis of estimation by t-test.

Hypothesis testing in this study using two-track ANAVA test, which is calculated by the program SPSS 17 for windows.

RESULTS

Data of students spatial ability can be seen in Table 2. Data is taken before the research is conducted.

Table 2. Description of Spatial Ability

Spatial Ability	Experimental Class		Controlled Class	
	Total	%	Total	%
Low	18	37.9%	8	27.4%
High	11	62.1%	21	72.4%

Description of learning outcomes is presented in Table 3. The frequency distribution of the number of students predicated on learning outcomes in each category can be seen as follows.

Table 3. Result of Students' Cognitive Learning

Group	Experimental Class	Controlled Class
X	83,3	72,9
N	29	29
Sd	9,2	10,7

Cross tabulation of spatial ability and learning outcomes in each category is presented in Table 4.

Table 4. Cross Tabulation of The Viewing Ability of Space and Learning Outcomes

Spatial Ability	Experimental Class	Controlled Class
High	X = 87,27	X = 75,64
	Sd = 8,7	Sd = 10,83
	N = 11	N = 21
Low	X = 80,95	X = 65,71
	Sd = 8,82	Sd = 6,66
	N = 18	N = 8

Furthermore, to be able to perform statistical tests of research data. Before the hypothesis testing is done the first test of normality and homogeneity test to determine the requirement of hypothesis testing. Normality test using normal test One Sample Kolmogorov-Smirnov Test with 95% significance level, using SPSS 17 for windows program. The output from One Sample Kolmogorov-Smirnov Test is shown in Table 5.

Table 5. Normality Test of Learning Outcomes

Class	A	Sig	Criterion	Conclusion
Experiment	0,05	.079	$\alpha < \text{Sig}$	Normal
Control	0,05	.200	$\alpha < \text{Sig}$	Normal

Table 6. Normality Test of Spatial Ability

Class	α	Sig	Criterion	Conclusion
Experiment	0,05	.200	$\alpha < \text{Sig}$	Normal
Control	0,05	.200	$\alpha < \text{Sig}$	Normal

Based on Tables 5 and 6, values of the significance of the experimental class and verification class > 0.05 indicate that the learning outcomes and spatial ability obtained from the experimental class and control classes are normally distributed. Furthermore, the homogeneity test variant of learning result data.

The homogeneity test of the learning data of the two classes used Levene test with the help of SPSS for Windows version 17 program. The result of homogeneity test is shown in Table 7 where the significance value is 0.157. With a significance value > 0.05 indicates the data distribution between the experimental class and the control class is homogeneous or has the same variant.

Table 7. The Result of Homogeneity Test of Data Score from Learning Outcomes Using Lavene Test

	α	Sig	Criterion	Conclusion
Learning outcomes	0,05	0,157	$\alpha < \text{Sig}$	Homogeny

Research hypothesis 1: there are differences in learning outcomes on the subject of the molecular shape between students taught with inquiry approach and verification approach tested the null hypothesis, H_0 : there is no difference in learning outcomes on the subject of molecular shape between students taught by inquiry approach and verification approach. An over spatial of the results of hypothesis testing is given in Table 8.

Table 8. Result of Hypothesis The Influence of Teaching Approach Toward Learning Outcomes

	Criterion	F_{observed}	F_{table} (0.05)	Conclusion
Hypothesis 1	$F_{\text{count}} > F_{\text{table}}$	25,811	3,16	H_0 omitted/ H_1 accepted

The result of hypothesis test shows that H_0 can be omitted, and this means the result of student learning which is taught with inquiry approach higher than the students who are taught by verification approach.

Research Hypothesis 2: there are differences in learning outcomes on the topic of the molecular shape between students with high spatial visibility and students with low spatial visibility tested through the null hypothesis, H_0 : there is no difference in learning outcomes on the subject of the molecular shape between students whose visibility ability is High compared to students with low spatial visibility.

The hypothesis of the test results as shown in Table 9 up to the conclusion that H_0 which is accepted, meaning that students' learning outcomes which have high spatial visibility are not always higher than students who have medium spatial ability space and low.

Table 9. Result of Hypothesis Test The Influence of Spatial Ability Toward Learning Outcomes

	Criterion	F_{observed}	$F_{\text{table (0,05)}}$	Conclusion
Hypotesis 2	$F_{\text{count}} > F_{\text{table}}$	9,44	3,16	H_0 accepted/ H_1 omitted

Research Hypothesis 3: there is an interaction between teaching approach and student's spatial ability for students learning outcomes tested through null hypothesis, H_0 : There is no interaction between inquiry teaching approach and students' spatial visibility to-ward students' learning outcomes.

The results of Hypothesis test as given in Table 10 conclusion is that H_0 accepted, means there is no interaction between inquiry learning approach with the ability of students' room perspective on student learning outcomes.

Table 10. The Result of Hypothesis Test of Interaction Teaching Approach of Spatial Ability

	Criterion	F_{observed}	$F_{\text{table (0,05)}}$	Conclusion
Hypotesis 3	$F_{\text{count}} < F_{\text{table}}$	0,47	3,16	H_0 accepted/ H_1 omitted

DISCUSSION

Learning outcomes in this study in the form of cognitive learning outcomes. The results show that

the learning outcomes of students who taught using inquiry approach are higher than the results of students' learning that taught using verification approach. It is caused by the opportunity to find their own concepts with the guidance of teacher's questions in inquiry approach. Students are led to answer the questions correctly, so they can explain why it can happen, discover relationships of one and another, observe the shape of molecules in three dimensions, analyze and draw the shape of molecules obtained from the results of the lab work they do. Understanding the materials through this approach will be saved in the long memory of students, which consequently can improve students' ability in memorizing. The more increase students' memory is proven by the score of their learning outcomes.

Inquiry-based learning is guided in this study, students appear to be more active in stabilizing initiatives to inquire, find answers to the "why?" The question of analyzing, modeling explanations and summarizing experimental results so that they eventually find their own concepts. They look more interested in learning, this means that their thinking motivation is also getting better when compared with students who were taught by verification approach. In addition, guided inquiry learning facilitates students in learning materials because learning is centered on students, and therefore allows students to help each other and be active in learning. The ability to work well with the students in the group on guided inquiry learning is the hope of learning so that students will gain experience in learning that will be useful in their life in the present and future socializing.

Villagonzalo (2014) examined the comparative performance of students during the learning that applied Huloon versioned inquiry models and traditional models. The results showed that students who applied the inquiry model guided version Hanson have better performance compared with students who applied conventional learning. So Villaganzalo concluded that Hanson's version of the inquiry model is an effective learning model for improving students' performance and academic performance.

According to Straumanis (2008) explained that the advantages of learning methods Inquiry Guided Hanson version is that learners can process information, critical thinking, problem-solving, communication, teamwork, management, and self-assessment, while the teacher as a facilitator is observing cognitive group work As well as in the affective domain. So learning by using guided inquiry Hanson version can contribute

to better learning outcomes because in the classroom there is a discussion among students to discuss a problem so that there is interaction face to face and skills in interpersonal relationships.

The implementation of Hanson's guided inquiry model in Indonesia also showed positive results. Widyaningsih (2012) states that Hanson's version of Inquiry model has a positive effect on students' cognitive, affective and creative learning outcomes. Ningsih (2012) also states that guided inquiry model can improve critical thinking ability and improve aspects of hypothesis, analyze and conclude. It can be seen that various research results show positive results from applying Hanson versioned inquiry model.

Based on data analysis using two path Anava, it can be concluded that student learning outcomes that have the high spatial ability are not always higher than students with adequate and low spatial ability. This situation is caused by the relationship between spatial ability and learning outcomes in the experimental class has a high capacity whereas the relationship between spatial ability with learning outcomes in the control class has low capacity so that the relationship of spatial ability and learning outcomes in the experimental class is higher than the class control, meaning that the treatment done in the experimental class is able to improve the learning outcomes better than the increase of learning outcomes in the control class.

High learning outcomes in molecular shape materials are not always determined by the ability of a high spatial ability, but can be influenced by several things, including mastering the materials, the understanding of the elements of the periodic system, the valence of electrons possessed by each element, the formula of Molecules shape in covalent compounds, so that students will be able to easily determine the number of PEB and PEI, then we can predict the shape of the molecule correctly.

The high spatial visibility will only able to imagine the shape of the molecule correctly, imagine the angle and be able to draw well but not necessarily to predict the molecular shape of a compound, if only known molecular formula alone, especially if it does not know the number of electrons around the central atom, it must be difficult to predict the shape of the molecule.

Increased students' learning outcomes in the classroom taught by inquiry approach are caused by several things, such as the students are fully engaged to find the material being studied and relate it to reality, it encourages students to think about the benefits and apply the material gained in daily life. In the inquiry

process, the students not only act as the recipients of the lesson through lectures or verbal teacher explanations, but the students play a role in experiencing, finding and applying the lessons they have learned. Student's skill in learning by using inquiry approach is a process that begins by imagining step of things activity. Then do a live experiment, and ultimately make a conclusion. The students' understanding ability is better because students can work directly with the invention by practicing it, the students are more motivated to think creatively, this guided inquiry approach is excellent for students who have the ability to visualize and also imagine because with this approach; students become more active and Directed directly at the essence of learning.

Based on two way ANOVA analysis using significance level 0,05 is gotten score F_{counted} lesser than F_{table} . Then H_0 is accepted. The last hypothesis in this study to determine whether there is an interaction between the way of teaching and the ability of the student's space perspective on the results of chemistry learning especially on the molecular material. Based on the data in chapter IV it can be concluded that there is no interaction between the way of teaching and the ability of the student's space view to the chemistry learning result especially on the molecular material.

The absence of interaction between the way of teaching with the ability of the view of the student space means the influence of learning with inquiry led to a positive influence on student learning outcomes. The low spatial ability of students taught in guided inquiry has a higher average learning outcome than those taught by verification. This shows the effect of better inquiry teaching, especially for students who have low space visibility, or in other words, there is a combined effect between the way of teaching with the ability of the student's space perspective on student learning outcomes.

During the process of learning using inquiry approach, the students are going to get beneficial. The ability of his spatial and communication between students will strengthen the retention of the knowledge or knowledge become longer and deeper. According to the result of the research Tiel (2011), Some of the visual spatial learner (learners who use the ability to view space) tells that learners listen the teacher explains materials with more verbals method, at the beginning learners able to pay attention but within minutes They are distracted because they are only looking at the teacher without understanding the materials. As though, it is common to say that this situation is consid-

ered as focus distraction. So the attention to something is low. In the opposite, if learners are playing video games or computer, they are able to focus. It is because of the computer is dedicated for visual learner or visual spatial learner. Also, Silverman (2002) the higher intelligence of learner will be visualized spatial learner with characteristics; primarily thinking in the form of the image which has power in visual, has good ability about space, study the concept as a whole, able to learn concept which is complicated easily. See the big picture, lose the detailed picture, must be through visualization to spell words, excellent in visual memory or long-term memory, learn the concept once and be able to master permanently; Does not require repetitions, builds problem-solving methods in its own way, is very good at seeing relationships.

It is very important that we focus to the of intelligence (ability) possessed by the students so as to adjust the way of learning that is right for them, in order to obtain a better understanding and embedded longer in their memories.

CONCLUSIONS

According to the final result and discussion above, we can conclude that the learning outcomes of students who are taught using inquiry approach are higher than students' learning outcomes who taught using verification approach. Beside of that, students learning outcomes who have high visibility ability to be higher compared to the learning outcomes of students who have low space view ability. There is no interaction between teaching approach with the ability to view the student room.

According to the conclusion of the research, there are several points to suggest toward the parties concerned. The suggestions that researchers want to raise are as follows. 1) For the school for IQ tests conducted provide more detailed information about the multiple intelligences that students have. By knowing the multiple intelligence of the students can be chosen the proper way of teaching, which is a more effective way of teaching to improve understanding and student learning outcomes. 2) To the teacher be more often utilize the use of inquiry approach, as proven to encourage a more meaningful learning situation and can bring life skills (life skills) owned by students. 3) To the teacher to utilize the data of multiple intelligences owned by the students as the basis for choosing the right way of teaching to improve understanding and student learning outcomes.

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