Jurnal Inovasi Pendidikan dan Sains
Vol. 5 No.3, Desember 2024: 126-132 ISSN 2721-9119 (Online)

THE EFFECT OF USING OBAK DELIK VIRTUAL REALITY MEDIA ON INCREASING THE VISUAL SPATIAL AND CRITICAL THINKING ABILITIES

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Accepted: October 15th 2024. Approved: December 15th 2024. Published: December 25th 2024

Abstract: One of the chemistry concepts that students often get low learning outcomes in class XI is the concept of molecular shape. Many students have difficulty describing the shape of molecules and this causes students to misunderstand molecular shapes because the shape of molecules is abstract and cannot be observed directly using the sense of sight. The research aims to determine the effect of using OBAK DELIK virtual reality media on the visual spatial and critical thinking abilities of students at SMA N 1 Tuban. The research used a one group pretest posttest design to determine visual spatial abilities and critical thinking abilities. Analysis of research data was carried out by analyzing diagnostic test results using the n-gain score. The results of research using OBAK DELIK media concluded that students' visual spatial and students' critical thinking abilities experienced a fairly effective increase with an n-gain of consecutively 0.621 and 0.618.

Keywords: obak delik, virtual reality, critical thinking

INTRODUCTION

Chemistry is a scientific discipline that investigates everything about matter, from its composition, structure, properties, to the changes that accompany it [1]. Chemistry is divided into two main aspects, namely the products produced and the processes that produce them. The two are closely related and cannot be separated. Chemical assessment involves three levels of representation which include macroscopic, submicroscopic and symbolic [2]. At the macroscopic level, students can directly observe various chemical phenomena that occur around them, both through experiments and daily observations. However, to understand chemical phenomena in depth, it is necessary to study the more abstract submicroscopic level, namely atoms and molecules. The symbolic level is then used to represent chemical phenomena more clearly such as chemical formulas, reaction equations, and graphs.

There is a gap in chemistry learning, crucial submicroscopic aspects are often ignored, thus hampering students' understanding of more complex chemical concepts [3]. In addition, the submicroscopic level is usually studied separately in certain materials. Chemistry learning that does not integrate the three levels of representation can cause misconceptions in students and hinder the development of students' scientific thinking. So that students can fully understand chemistry, learning must pay attention to proportions at all three levels of representation, both macroscopic, submicroscopic and symbolic. Based on this, chemistry learning is needed by integrating the three levels of representation to produce a deeper and more meaningful understanding. Applying all three levels of representation simultaneously can improve understanding of chemical concepts [4].

Apart from the representative level of chemical concepts, the order in which chemistry learning is delivered is very important because chemical concepts are built hierarchically. Understanding chemical concepts is cumulative, where mastery of basic concepts is an important foundation for learning more complex concepts. Therefore, learning chemistry must start from the most basic concepts. Understanding basic concepts first will make it easier for students to learn more complex concepts. Chemistry learning that does not follow a logical sequence according to the hierarchy of chemical concept material can cause misconceptions [5].

One of the chemistry concepts that students often get low learning outcomes in class XI is the concept of molecular shape. The concept of molecular shape is one of the important foundations in chemistry. The shape of a molecule is not just a visual representation, but is also related to the physical and chemical properties of a substance through understanding the concepts of polarity and intermolecular forces. Understanding chemical concepts is closely related to the ability to estimate the location of atoms in a molecule through understanding the level of chemical representation, namely submicroscopic, so that it will minimize the occurrence of misconceptions in students.

Preliminary test results show that more than 50% of students have difficulty understanding and describing the shape of molecules in three dimensions. The students' difficulties were caused by several factors, including the inability to determine bonding and free electron pairs and a lack of understanding of VSEPR theory. This indicates that students' understanding of spatial concepts in chemistry still needs to be improved. Apart from that, students had the most difficulty predicting molecular shapes, with a percentage of 78.57%.

In line with previous research Anshori et al. [6], interviews with students showed that difficulties in understanding the concept of molecular shape were closely related to three-dimensional

visualization abilities. The majority of students expressed difficulty in imagining the location of the atoms in a molecule and describing the shape of the molecule accurately. This indicates that abstract concepts such as molecular shapes need to help students visualize these abstract concepts so that students can understand the concepts well. Students' visualizing abilities are related to students' visual spatial abilities. Students' difficulties in understanding the concept of molecular shape are closely related to students' lack of visual spatial abilities. Visual-spatial abilities are essential for imagining and processing information in three dimensions. As emphasized by Anshori et al. [6] weak visual spatial abilities can hinder students in predicting molecular shapes. Visual spatial abilities with the ability to translate mental images into two orthree dimensional visual forms.

Based on the situation and challenges faced by students in understanding the concept of molecular shape, media is used that can help students visualize abstract concepts. One use of virtual reality (VR) media can be an innovative solution. Through VR media, students can directly interact directly from various points of view [14] Through the immersive and interactive experience of VR media, students can build a deeper and more concrete understanding of molecular shape. Apart from that, VR can also accommodate various student learning styles needed by students [7].

In the learning process, developing cognitive abilities must be balanced with honing abilities such as the ability to think critically. The concept of molecular shape is material that is quite difficult for students to comprehend and comprehend, so students are required to have high-level thinking such as the ability to think critically in understanding the material. Based on the results of the initial test of students' critical thinking abilities, it was found that the average results of students' critical thinking were in the low category. It is important to develop critical thinking skills, apart from being able to support students to better understand the material, critical thinking skills are one of the characteristics developed in the Pancasila student profile. Critical thinking ability is one of the abilities that needs to be developed so that students will be ready to face future challenges through the ability to solve problems and make logical and rational decisions.

Based on the background that has been explained, it is necessary to carry out research with the title The Effect of Using OBAK DELIK Virtual Reality Media on Increasing the Visual Spatial and Critical Thinking Abilities of SMA N 1 Tuban Students. OBAK DELIK Virtual Media is an acronym for Orientasi Bentuk dari Molekul dengan Sekali Lirik.

RESEARCH METHODS

The innovation design for the use of OBAK DELIK virtual reality media in the molecular shape concept uses a one group pretest posttest design research design to determine the increase in visual spatial abilities and critical thinking abilities.

The treatment instrument is a learning tool in the form of a teaching module on the concept of molecular shapes and the virtual reality media OBAK DELIK. Before being used as an instrument, the learning tool has been validated by validators collaboratively. The validators are two chemistry subject teachers at SMA N 1 Tuban and 1 lecturer who teaches science concepts subjects. Apart from treatment instruments, treatment outcome measurement instruments were also developed, which are instruments in the form of tools for assessment. The measurement instruments consist of visual spatial ability test instruments and critical thinking ability tests. The visual spatial ability test developed from Gardner's theory consists of 20 questions. which consists of 5 questions related to perceptual thinking, 5 questions related to image classification, 5 questions related to logical consistency and the last 5 questions related to image identification. The critical thinking ability test is in the form of a diagnostic test in fourtier test format. The test consists of four levels, namely: Tier 1: Questions or question statements, Tier 2: Scale of confidence in choosing answers, Tier 3: Reasons for answers, Tier 4: Scale of confidence in reasons for answers. The measurement instrument is first tested for validity and reliability.

Content validity is used as the degree of representation of the aspect of ability to be measured in the instrument items. The criteria for content validation are that the questions prepared have communicative sentences and contain the concept being measured. Content validity shows that the test instrument developed is suitable for measuring visual-spatial abilities and visual-spatial abilities. The validity results obtained will be analyzed using the percentage analysis technique as follows.

$$P = \frac{\text{number of validator scores}}{\text{total score}} \times 100\%$$

Test instrument eligibility criteria can be seen in Table 1.

Table 1. Test Instrument Eligibility Criteria

Presentation	Meaning
0 % - 20 %	Very low
21 % - 40 %	Low
41 % - 60 %	Currently
60 % - 80 %	High
81 % - 100 %	Very high

The content validity of visual spatial abilities and critical thinking abilities shows that the test instruments prepared are suitable for use. The average validation results for visual spatial content were 78.74% and critical thinking skills were 68.67%.

The technique used to determine validity in research is product moment Person correlation with the help of the SPSS 19 for Windows program. To interpret the validity of the questions, the following criteria are used:

• Items with r calculated> r table at a significance level of 0.05 are considered valid

• Items with r calculated < r table at a significance level of 0.05 are considered invalid

The results of the validity analysis of the visual spatial ability items showed that there were four numbers that were invalid, namely 5, 10, 13, and 20 because these four items had rcount < rtable at a significance level of 0.05. Meanwhile, the results of the validation analysis of critical thinking ability items show that there are two invalid numbers, namely 5 and 6 because both items have rcount < rtable at a significance level of 0.05. Invalid question items are corrected by analyzing the possibility of things that students do not understand related to the question based on the validator's suggestions.

The technique used to determine reliability is Cronbach's Alpha with the help of the SPSS 19 for Window program. The overall test reliability criteria can be seen in Table 2.

Table2. Test Reliability Criteria

Correlation figure	Meaning
0,800 < r < 1,000	Very high
0,600 < r < 0,800	High
0,400 < r < 0,600	Currently
0,200 < r < 0,400	Low
0,000 < r < 0,200	Very low

The results of the reliability analysis of the visual spatial ability test provide a test reliability criterion of 0.738. Meanwhile, the critical thinking ability test provides a test reliability criterion of 0.649. The results of the test reliability criteria stated that the twenty visual spatial questions and 10 critical thinking questions had high test reliability criteria.

Determining the position of students' visual spatial abilities is carried out by determining the categories of visual spatial abilities and critical thinking based on the average and standard deviation. The average and standard deviation can be calculated using the following formula.

$$Mi = \frac{\sum xi \;\; x\, n}{\text{n}} \qquad SD = \sqrt{\frac{\sum_{fi\, x\, (xi-x)}\, 2}{(n-1)}}$$

Where:
Mi = Mean (average)
SD=Standard Deviation
fi = 1st to nth x frequency
xi = i to nth x value
n = number of Intervals

Based on data about students' visual spatial and critical thinking abilities, the ideal maximum score, ideal minimum score, ideal average (Mi) and standard deviation (SDi) were achieved. After carrying out the calculations, the ideal average price (Mi) = 1/2 (100+0) = 50 and the ideal standard deviation (SDi) = 1/6 (100-0) = 16.7. Thus, categories can be created for the data component scores of students' visual spatial abilities and critical thinking in Table 3.

Table 3. Categories of Students' Visual Spatial Ability and Critical Thinking

	Categories
Mi + 1 SDi until Mi + 3 SDi 50 + 16.7 until 50 + (3 x 16.7) **66,7 until 100**	**High**
Mi - 1 SDi until < Mi + 1 SDi 50 + 16.7 until 50 – 16.7 **33,3 until 66,7**	**Currently**
Mi – 3 SDi until < Mi + 1 SDi 50 + (3 x16.7) until 50 – 16.7 **0 until 33,3**	**Low**

Determining the increase in students' visual spatial and critical thinking abilities by calculating the difference between the pretest score (initial assessment results) and posttest (final assessment

results) using the N-Gain Score. The Normalized Score (N-Gain Score) can be calculated using the following calculation guidelines.

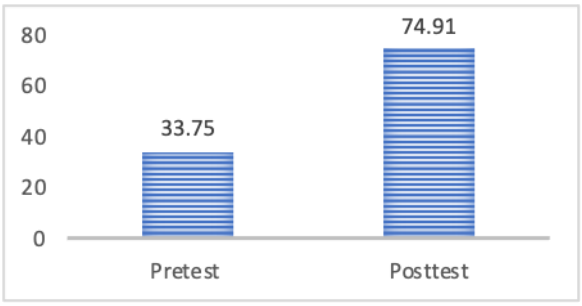
$$\text{N Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{Ideal score} - \text{pretest score}} \times 100\%$$

Table 4. Categories of Interpretation of N-Gain Effectiveness

Presentation	Meaning
< 40	Ineffective
40 - 55	Less effective
56 - 75	Quite effective
>76	Effective

RESULTS AND DISCUSSION

The results of students' visual spatial abilities can be seen in Figure 1 and the determination of the increase in students' visual spatial abilities can be seen in Table 5.



Fiture 1. Average Pretest and Posttest Results of Students' Visual Spatial Ability

Table 5. Results of Pretest Scores, Posttest Scores, Ideal Scores from Results Student Spatial Visuals

Pretest score	33,75
Posttest score	74,91
Ideal score	100
n-gain	0,621
Category	Quite efffective

After calculating the increase in visual spatial abilities, the indicators that have increased can be seen in Figure 2. The visual spatial experience that students have during learning with appropriate visual media and real experience will form formal thinking stages so that it can influence increased student learning outcomes. The results of increasing visual spatial abilities in the research are in line with research by [8][9][10][11].

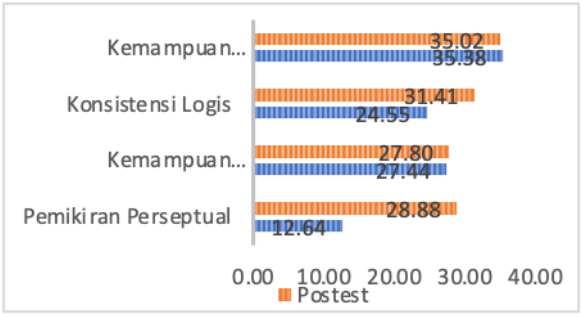


Figure 2. Results of Each Spatial Visual Ability Indicator

Based on the average pretest results, students' visual spatial abilities in Figure 1 are in the low category. Meanwhile, based on the average results of the posttest, students' visual spatial abilities in the concept of molecular shape are in the high category. The differences that can be seen from before and after the use of OBAK DELIK virtual reality media. Before using the virtual reality media OBAK DELIK, students only acquired the concept of molecular shapes by using image media from books or drawn by the teacher on the blackboard. There are students who have good abilities in imagining their minds to connect geometric shapes in three dimensions, but there are not many students who do not have this ability. This is in line with Piaget's opinion. Cognitive development according to Piaget, middle/high school age students should be at the abstract or formal operational thinking stage. However, the reality is that there are still many middle/high school age students who are still at the concrete operational stage. Based on these facts, the OBAK DELIK virtual reality media is one of the

media that helps students visualize the concept of abstract molecular shapes so that students' understanding of the concept increases. OBAK DELIK Virtual reality media provides alternative student learning styles with immersive experiences and interactions that will make students' understanding more meaningful. Meaningful understanding can form long-term memory for students thereby increasing student retention.

Determining the increase in students' visual spatial abilities by calculating the difference between pretest and posttest scores using the N-Gain Score can be seen in Table 5. Based on the results of the analysis using n-gain, the results obtained show that the use of OBAK DELIK Virtual reality media is quite effective in increasing visual spatial abilities. students on the concept of molecular shape with an n-gain score of 0.621. Based on the results of the analysis with n-gain, the results were obtained that the use of OBAK DELIK Virtual Reality Media was quite effective in improving students' visual spatial abilities on the concept of molecular shape.

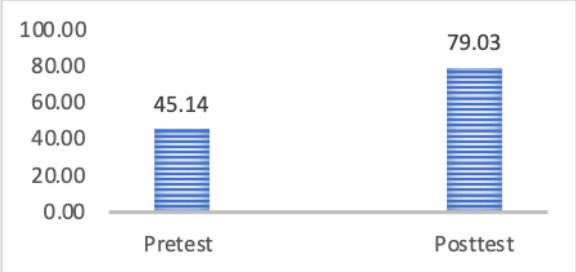
Through the use of OBAK DELIK virtual reality media, students have experience in interpreting molecular shapes according to their learning style. Before they learn from the learning resources available in the OBAK DELIK virtual reality media, students have initial knowledge about bonding electron pairs (PEI) and lone electron pairs (PEB), electron domain theory, and VSEPR, and students must know the shape of molecules contextually including size. atoms, the location of the atoms in the molecule and the color of each atom you want to create. Next, students collaboratively carry out discussion activities on the LKPD given by the teacher as seen in the learning activities in Figure 3.

Fiture 3. Discussion Activities Using Virtual Reality Media OBAK DELIK.

Through the OBAK DELIK virtual reality media, students can explore a three-dimensional environment that is specifically designed based on learning objectives so that they can get a good immersive experience and make it easier for students to understand abstract and complex concepts. This is in line with the thoughts of Zulfikasari, et al [12] who state that VR allows students to interact directly with learning material in an immersive virtual environment. This immersive and interactive experience allows students to build a deeper and more concrete understanding of the concept of molecular shape. This is one of the factors that causes an increase in the visual spatial ability category from the low category to the high category.

After analyzing the visual-spatial ability indicators, adapting Gardner which consists of 4 indicators, results were obtained as in Figure 2. The four indicators that gave significant improvement were the increase in the indicators of pespectual thinking. This shows that the OBAK DELIK virtual reality media is effective in increasing students' perception so that students can know the location of the atoms of a molecule, the color of each atom, and the position of the central atom with other atoms in three dimensions. These results are in line with the opinion of Achdiyat [13] who states that visual spatial ability is the ability to visually perceive abstract concepts so that it involves spatial relationships which include orientation to complex abilities involving manipulation and mental rotation.

The results of students' critical thinking abilities can be seen in Figure 4 and the determination of the increase in students' visual spatial abilities can be seen in Table 6.

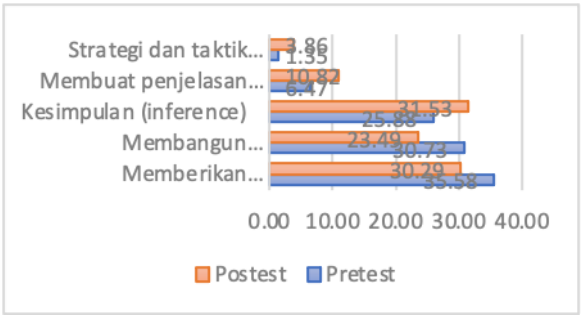


Fiture 4. Average Results of Pretest and Posttest Critical Thinking Ability

Table 6. Results of Pretest Scores, Posttest Scores, Ideal Scores from Results Students' Critical Thinking

Pretest score	45,14
Posttest score	79,03
Ideal score	100
n-gain	0,618
Category	Quite efffective

After calculating the increase in critical thinking skills, the indicators that have increased can be seen in Figure 5. The significant increase in students' critical thinking results after using virtual reality media can explain that providing real learning media can improve their critical thinking stages so that students' metacognition is also better. This is in line with the research results of Utami et al [14], Jannah & Admojo [15] on learning research using virtual laboratories and digital media. The results of increasing critical thinking abilities in the research are in line with research by Khairunnisa [16], Zulherman et al [17], Oktarizka & Abidin [18] and Supriadi, & Hignasari [19].



Fiture 5. Results of each indicator of critical thinking ability

Based on the average pretest results, students' critical thinking abilities in Figure 5 are in the low category. Meanwhile, based on the average results of the posttest, students' critical thinking abilities on the concept of molecular shape are in the high category. Determining the increase in students' critical thinking abilities by calculating the difference between the pretest and posttest scores (using the N-Gain Score which can be seen in Table 6. Based on the results of the analysis using n-gain, the results obtained show that the use of OBAK DELIK Virtual Reality Media is quite effective in increasing abilities students' critical thinking on the concept of molecular shape with an n-gain score of 0.618.

Through the virtual reality media OBAK DELIK, it allows students to understand information, analyze it in depth, and then draw logical conclusions. These research [18] who stated that the use of VR can stimulate students to think critically and students will understand much better that something virtual feels real. By thinking critically, students can develop the ability to think rationally and make students active in learning. This ability is not only visible during the learning process, when students actively seek information and analyze problems, but is also reflected in the learning outcomes they achieve. The higher the student's critical thinking ability, the better the quality of learning that the student has gone through. The quality of a learning process can be assessed from various aspects, one of which is students' ability to think critically. The ability to think critically is one of the characters developed in the Pancasila student profile because students are required to think holistically. Critical thinking is one of the abilities that needs to be developed so that students will be ready to face future challenges.

After analyzing the critical thinking indicators, the results obtained are as in Figure 4. Based on these 5 indicators, the results that provide significant improvement are the conclusion indicators. This shows that the OBAK DELIK virtual reality media is effective in improving students' ability to make conclusions. This is in line with the opinion of research [20] who explains that critical thinking is a cognitive process that involves interpretation, analysis, evaluation, inference, explanation and self-regulation. In this way, students will have the ability to understand information, analyze the information in depth, and then students can draw logical conclusions based on existing evidence.

CONCLUSION

The results of research using the OBAK DELIK Virtual Reality media concluded that (1) students' visual spatial abilities experienced a fairly effective increase with an n-gain of 0.621, (2) students' critical thinking abilities experienced a fairly effective increase with an n-gain of 0.618.

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