# Problem-Based Learning Using Virtual Reality Media at Islamic Senior High School in Bekasi

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| ARTICLE INFO | ABSTRACT |
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| | This study aims to investigate the improvement in the quality of learning biology, especially about the anatomy of the human body after using virtual reality media "The Body VR: Journey inside a Cell". This study employed pre-experimental research with a one-group pretest-posttest design which was chosen at random, and no stability and clarity tests were performed before the group was given treatment. According to the findings of data analysis and field research at an Islamic Senior High School in Bekasi, students struggled to understand the anatomy of the human body in biology lectures. Observation data suggest that learning outcomes remain poor, at 65%, and problem-solving abilities remain low, at 70%. There are significant differences in students' analytical abilities in distinguishing, organizing, and attributing using Virtual Reality media compared to those who do not participate in Virtual Reality media learning in biology subject XI MIPA. This research recommended to pay greater attention to the use of suitable learning material, as well as to create additional space and facilities for instructors and students to use throughout the learning process. Also, the school must provide new breakthroughs in learning, such as updating up-to-date or up-to-date learning media and educating instructors to design and apply them. |

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## 1.    INTRODUCTION

Virtual Reality (VR) is one technology that may be used as a learning medium in the education sector (Riemann et al., 2020). Virtual Reality (VR) offers immersive simulations that allow users to engage while also feeling as though they are in a virtual world (Carpendale & Cooper, 2020). Virtual Reality (VR) technology is a method of displaying learning images in the form of three-dimensional media, also known as 3D, in which this process is made with the assistance of computer components to make the results appear more realistic, as well as the assistance of a number of other important tools. This will immediately and physically make its users (students) feel in a predefined setting. It is envisaged that with the growth of smartphone technology, the notion of engaging in the learning process would become easier to employ. Quality learning may be defined as student-centered rather

than teacher-centered (Munir, Vogel, & Jacobsson, 2022). Teachers who are not active, creative, innovative, effective, and choose fun method models may lead students to become bored in learning, which causes students' learning motivation to decrease (Analoui, Sambrook, & Doloriert, 2014), especially when dealing with subject matter that is considered difficult and requires a lot of memorization. Based on observations from several schools, it was discovered that some students found biology lessons difficult because the material was very dense, biology concepts were abstract, and the lack of media use made it difficult for students to understand the material (Wearmouth, 2017).

Afri Tri Fardani (2020) conducted research at the high school level from 2010 to 2020 and discovered that (1) the use of Virtual Reality technology in the teaching and learning process is very influential and supportive of material whose conditions are displayed in the form of visualization, and (2) interest from users who tend to be very high towards the use of Virtual Reality technology in learning. (2) The usage of virtual reality media has a considerable influence on students' pleasure and comprehension of the topic being taught. 3) The use of Virtual Reality media in learning can improve learning effectiveness and efficiency by saving time and money. 4) Virtual reality is a new technology that is being used in the world of education since it has its own set of benefits and has good quality and feasibility when used for learning, such as history or other subjects of science.

According to 's (2018) research on biology learning, the resultant virtual reality can enhance learning about animal cells. The resultant animal cell visualization tool may assist students in better understanding the structure and content of animal cells. Because cell organelles are minuscule, it is simpler for pupils to grasp the structure of animal cells, which are so intricate that the eye cannot reach them. Aside from that, it contributes to instructors' excitement about furthering the development of Virtual Reality, particularly in the area of science, particularly for subject topics that require a lab environment to be designed into a Virtual Lab.

Each daily repetition has an average value of 50% below the Minimum Completeness Criteria (KKM), indicating that pupils are having difficulty acquiring students' anatomy information. Another study discovered that students' learning outcomes on the structure and function of animal tissue material have not yet reached the KKM as a whole. The percentage of pupils who did not complete this subject was 100%. According to research, students have little interest in reading biology textbooks, and 70% have trouble understanding human anatomy information. Meanwhile, 76.7% of students had difficulties recalling the human movement system curriculum that had been presented since the material had been remembered rather than understood.

The condition was also discovered at a Private Islamic Senior High School in Bekasi. According to the findings of interviews with three biology professors at the school, students struggled to understand the anatomy of the human body in biology lectures. Observation data suggest that learning outcomes remain poor, at 65%, and problem-solving abilities remain low, at 70%. The occurrence of monotonous learning that tends to lecture and lacks practice causes students to feel bored and have trouble assimilating content during biology sessions. These settings have a detrimental influence on students since they are unable to meet planned learning objectives (Fadila et al., 2020). Because one course and other materials are interconnected, a lack of comprehension of biological ideas might make it difficult for teachers and students to continue the material thereafter. This will have an impact on students' biology learning outcomes (Thamrin, Saidun Hutasuhut, Aditia, & Putri, 2022).

Dissatisfaction with learning results makes it difficult for teachers to modify the learning process (Alam Putra, Sofendi, & Sitinjak, 2022). If learning enhancements are not implemented, students' conceptual comprehension and, as a result, learning outcomes will suffer (Brady & Asselin, 2016). Problem-based learning (PBL) is another feature that must be developed. Problem-based learning is the capacity to gather knowledge, assess situations, and recognize difficulties to generate alternatives and make decisions to attain goals (McGunagle & Zizka, 2020). Problem-Based Learning (PBL) is intended to engage and stimulate students in problem-solving processes. Each student will get problem orientation, arrange students to undertake investigations, conduct investigations alone or in groups,

generate and present findings, and analyze and evaluate issues throughout the problem-based learning (PBL) stage (Permana, Chamisijatin, & Zaenab, 2021).

From the explanation above, it can be seen that there are difficulties for students in understanding learning about human anatomy, which can be seen from the number of students with scores below the KKM. Therefore, schools and teachers are looking for alternative methods to be able to improve the quality of learning biology by using virtual reality. This study aims to see the improvement in the quality of learning biology, especially about the anatomy of the human body after using virtual reality media The Body VR: Journey inside a Cell. The Body VR: Journey inside a Cell is a virtual reality educational experience that transports the user into the human body. Explore the circulation and learn how blood cells work together to provide oxygen throughout the body. Enter one of our body's billions of live cells and see how the organelles collaborate to battle harmful infections. Students may examine the body as if they were within the cells and stroll through it using this program. Aside from that, during their tour within the body, students will learn a lot of medical knowledge about the human body that is not as complex as normal because it is presented in a more entertaining manner.

## 2.  METHODS

This study employed pre-experimental research with a one-group pretest-posttest design, which means that experimental research was conducted in just one group, which was chosen at random, and no stability and clarity tests were performed before the group was given treatment. For each learning series, the study design of the one group pretest-posttest design was measured using a pre-test conducted before treatment and a post-test conducted after treatment (Sugiyono, 2018) As a result, the treatment's outcomes may be predicted more precisely. Each course will include a pre-test and post-test to avoid bias from the study results. The research population consisted of all students in class XI MIPA at SMAIT Tariq Bin Ziyad, Bekasi, during the odd semester of the 2020/2021 academic year. Meanwhile, the sample for this study was drawn from a subset of the whole population using purposeful random sampling, a sampling approach with specified constraints. The factor in issue is that the class employed as the research sample is thought to be representative of the public because it is a class with an expertise program chosen by around 80% of high school students (Creswell & David Creswell, 2018). The field studies included three classes: the first experimental class, the second experimental class, and the control class, which were chosen at random from all XI MIPA courses at SMAIT Thariq Bin Ziyad in Bekasi. The three classes addressed the same biological topic, the anatomy of the human body. The distinction is in how each class is treated.

The research approach is divided into two stages: preparation and implementation. The preliminary stage included biological material analysis, syllabus analysis and the creation of Learning Implementation Plans (RPP), the production of test instruments based on biological anatomy material, and instrument testing, which included validity and reliability tests. The implementation step next includes administering pre-test questions, conducting Problem Based Learning (PBL) using The Body VR application media, and administering post-tests. In the first experimental class, the second experimental class, and the control class, test questions and observation sheets for science process skills were utilized to assess and observe students' science process abilities. The pretest and posttest procedures are used to assess science process abilities in the form of multiple-choice questions, while the observer fills out the observation sheet in each learning process.

The test instrument used is in the form of essay questions, with 7 questions provided at the start (pre-test) and end (post-test) of learning to determine the improvement in knowledge of biological content on the anatomy of the human body. The problem statement is an adaptation of an existing query. The non-test instrument utilized was a questionnaire with 20 questions on learning processes and approaches used before and after using VR. Data collecting approaches using test and non-test procedures were used, and quantitative data analysis techniques with descriptive analysis were used. Descriptive analysis is used to evaluate the features of the data collected in order to examine students'

mastery of the topic and the influence of VR-based learning approaches on the quality of biology learning outcomes. The following is the lattice of the biology learning process skill instrument utilizing VR:

**Table 1**. Field Trial Design

| Group | Pretest | Implementation | Posttest |
|---|---|---|---|
| Experiment Class 1 | O1,O2 | $X_1$ | O1,O2 |
| Experiment Class 2 | O1,O2 | $X_2$ | O1,O2 |
| Control Class | O1,O2 | $X_3$ | O1,O2 |

Shells:
O1 : test and observation before learning
O2 : test and observation after learning
X1: implementation of practical learning using THE BODY VR media
X2: implementation of real practicum learning X3: implementation of learning using video media.

**Table 2**. Comparison of learning designs

| Scientific approach step | Class | | |
|---|---|---|---|
| | **Experiment 1** | **Experiment 2** | **Control** |
| Observe | Observing student worksheets | Observing student worksheets | Observing student worksheets |
| Ask | Raised a question | Raised a question | Raised a question |
| Collecting data | Practicum using THE BODY VR media (Biology) | Real practicum | Using the commonly used media, namely video |
| Analyze | Discussion | Discussion | Discussion |
| Communicating data | Q&A, Presenting | Q&A, Presenting | Q&A, Presenting |

## 3. FINDINGS AND DISCUSSION

Field experiments are studies of products that follow limited testing. The research was carried out by comparing the efficiency of VR media with biology laboratories and media typically used in schools in delivering body anatomy content in order to improve students' science process abilities and scientific attitudes.

### 3.1. *Science Process Improvement Analysis (Biology) Results*

Data on students' scientific process abilities were gathered by administering 20 questions on biology learning process skills before (pretest) and after (posttest) therapy.

**Table 3.** n-gain Science Process Skills (Biology) Results

| No | Class | Average Score | | Average n gain | Category |
|---|---|---|---|---|---|
| | | Pretest | Postest | | |
| 1 | Experiment Class 1 | 73,45 | 87,56 | 0,45 | Moderate |
| 2 | Experiment Class 2 | 75,67 | 85,35 | 0,41 | Moderate |
| 3 | Control Class | 67,57 | 76,67 | 0,37 | Low |

According to the analysis results, the average n-gain in the first experimental class is greater than that in the second experimental class and the control class. It may be inferred that the first experimental class students improved their science process abilities faster than the second experimental class and the control class. The second experimental class then has a greater average n-gain than the control class. The first and second experimental classes have moderate n-gain categories, while the control class has a low n-gain category. The assessment of science process abilities includes parts of observing, categorizing, analyzing data, and communicating.

There is a very tiny variation in n-gain in the component of science process skills (Biology) categorizing and conveying. The classification and communication aspects for the difference in n-gain between the two experimental classes and the control are 0.01 and 0.05, respectively. This demonstrates that neither the features of categorizing nor communicating increased significantly in classes that utilized real practicums nor those that used video media. The difference in average pretest and posttest scores shown in Table 4 below demonstrates the improvement in science process skills (biology).

**Table 4**. Results of Difference in Average Scores of Science Process Skills (Biology)

| No | Class | Average Score | | Difference (J-I) |
|----|-------|---------------|---|------------------|
| | | Pre-test (I) | Post-test (J) | |
| 1 | Experiment Class 1 | 65,75 | 87,92 | 22,17 |
| 2 | Experiment Class 2 | 74,83 | 83,45 | 8,62 |
| 3 | Control Class | 63,45 | 66,77 | 3,32 |

The statistics in the table reveal that the first experimental class had the greatest difference in average scores. The difference in average scores between experimental classes 1 and 2 was greater than the difference between experimental classes 3 and 4. This demonstrates that courses that utilize VR-Biology media improve their science process abilities more than classes that perform real labs or those that use video. The difference in the average score of science process abilities in the second experimental class is bigger than the difference in the control class, however, it is only 5.30. This demonstrates that the difference in science process abilities between students who undertake real lab work and ones that use videos is not statistically significant.

**Table 5.** Scientific n-gain result

| No | Class | Average Score | | Average n-gain | Category |
|----|-------|---------------|---|----------------|----------|
| | | Pretest | Posttest | | |
| 1 | Experiment Class 1 | 43,35 | 48,67 | 0,37 | Moderate |
| 2 | Experiment Class 2 | 40,85 | 45,35 | 0,34 | Moderate |
| 3 | Control Class | 38,25 | 47,62 | 0,26 | Low |

### 3.2. *The results of the analysis of increasing scientific attitudes*

Data on improving scientific attitudes may be shown in changes in questionnaire score acquisition at the beginning and conclusion of learning. According to the analysis results, the average n-gain in experimental class 1 is greater than that in experimental class 2 and control. It is possible to conclude that the growth in the scientific attitude of students in experimental class 1 is greater than that of students in experimental class 2 and the control class. The experimental class 2 then has a greater average n-gain than the control class. Furthermore, the findings of the observations revealed that the pupils in experimental class 1 had a more scientific attitude than those in experimental class 2 and the

control group. Curiosity, honesty, and critical thinking are components of the scientific mindset investigated.

### 3.3. Discussion

Media The Body VR offers experimental simulations that can be accessed offline, allowing students to repeat these simulations whenever and wherever they choose. This is reinforced by Pleh's (Morehead et al., 2014) research, which claims that VR technology can readily imitate numerous science and engineering situations, considerably decreasing the expenses and dangers of doing tests in actual laboratories. Furthermore, via experimenting, VR technology can stimulate or create some sights and effects that are not possible in the actual world. Conditions may be altered and managed in a variety of ways. Furthermore, due to the participatory character of such teaching approaches, a clear and pleasurable learning environment is provided (Mourtzis, Vlachou, Dimitrakopoulos, & Zogopoulos, 2018).

The attractiveness of this media is consistent with the benefits of media expressed by Stachura (2021) namely that learning can be more interesting due to the clarity and sequence of messages, changing images, and the use of special effects that can arouse curiosity, cause students to think, and can cause students to laugh. According to Almulla (2020), a type of activity that pertains to the attitude of students may be used to promote students' critical thinking. When pupils are given tasks to solve, indications of critical thinking abilities in settings (situations) are trained. Students are presented with real-world difficulties in real-world scenarios, and they may apply all relevant facts to the challenges presented (Krúckhans et al., 2015).

The benefit of The Body VR (Biology) is the presence that allows the user to be present in the virtual environment and have a real experience. Students may examine the body as if they were within the cells and stroll through it using this program. Aside from that, during their tour within the body, students will learn a lot of medical knowledge about the human body that is not as complex as normal because it is presented in a more entertaining manner. However, this program has various flaws, including the inability to fill out student worksheets that are not compatible with the media. Furthermore, when utilizing The Body VR (Biology), teachers are unable to monitor student participation. This media also does not support all devices, because running the program requires a computer with a specified capacity that fulfills the application requirements, as well as headphones that support the Stream application.

The media expert validator and material expert validator both assigned a feasibility value to the Body VR media product. A practicality evaluation is also required to determine how applicable the generated goods are to classroom scientific (biology) learning. Furthermore, product constraints were derived from student replies. After incorporating ideas and comments from the validator, the Body VR media product is ready for usage in the learning process.

Based on the findings, multimedia such as simulations, interactive animations, quizzes, web-based learning tools, practicum, videos, lectures, and self-evaluations help students learn more effectively and competently. The lack of a significant difference in science process abilities between the second experimental class and the control class revealed that real-world practicum activities were just as effective as video-based learning. Unfortunately, these findings contradict past research. According to  (2020), practicum has been widely acknowledged for its ability to assist the acquisition of scientific ideas and abilities. According to Cajkler & Wood (2019), students needed additional practicum to develop their science process abilities. This is crucial in developing students' comprehension of, and capacity to recognize and apply relevant scientific evidence in problem solving and decision making (Harlen, 2000). Students can use these abilities to gather data, run cooperative experiments, evaluate data, and develop outcomes.

Some of the reasons of genuine practicum are as excellent as viewing films, such the use of replacement instruments to replicate the aims of practicum activities and the fact that not all students

actively participate in practicum activities. Some students merely record results or observe other pupils doing experiments. Furthermore, students who watch videos rely solely on images and voice, which, of course, do not include interactions between students and the thing being seen. The lack of a significant difference in scientific attitude between the second experimental class and the control class suggests that completing real practicums and using video media are equally effective and have no effect. This was also seen in research undertaken by Singh et al., (2022), in which learning activities employing the practicum technique resulted in no change in scientific views.

There is a reason why there is no change in the scientific attitudes of students between the first experimental class and the control class, which is that there are no training sessions in using The Body VR media prior to the learning process. According to Raes et al. (2020), some students are having difficulty adjusting to the new system. As a result, students are still perplexed about how to use virtual reality technology.

The subsequent study of science process skills found substantial differences between students in the first experimental class and the second experimental class, as well as between the first experimental group and the control class. There was, however, no statistically significant difference between pupils in the second experimental session and those in the control class. The analysis's end outcome is the discovery of the greatest science process skills in the first experimental class.

## 4.    CONCLUSION

Data analysis and field research show that students' analytical abilities in biology subject XI MIPA SMAIT Thariq Bin Ziyad are significantly different when they use VR media for learning compared to when they do not. This is particularly true when it comes to distinguishing, organising, and attributing. In light of the recommendations drawn from the analysis of the research data presented above, the results of this study could serve as a foundation for future work on SMAIT Thariq Bin Ziyad. Consequently, the researcher offers a plethora of suggestions that could be considered in light of the research and its findings, including 1) The needs of students' learning evolve over time, thus it's important for subject teachers to prioritise technology and utilise current learning media. This will help students adapt to new challenges and scopes. 2) Institutions of higher education, the study's author suggests that institutions like SMAIT Tariq Bin Ziyad prioritise the use of appropriate course materials and dedicate more resources to making classrooms and other learning spaces conducive to students and teachers. Therefore, it is the responsibility of the educational institution to provide innovative approaches to education, such as training teachers to create and implement cutting-edge learning material. 3) The research suggests that the Department of Curriculum and Educational Technology should do more to help students become qualified and competent teachers who can make all the parts of learning more innovative, effective, and up-to-date by designing, using, and developing learning media. four) Scholar The researcher then recommends additional studies, this time focusing on learning medium. 5) Currently, the project only makes use of a single virtual reality application, which is a biology lesson on human cells. So that other virtual reality applications can be explored for further knowledge in future studies.

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