Proceeding International Conference on Religion, Science and Education (2024) **3**, 463-468

3D Holo-Learning Based on Holograms as an Interactive Learning Media for High School Students in Malang District

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Abstract: The quality of Indonesian education is still relatively low. Indonesia is ranked 54th out of 78 countries below Slovenia regarding the quality of education. Learning in Indonesia still uses a generalist theoretical approach which does not apply technology in delivering the material which has an impact on the lack of development of creativity and expertise in the field of science and technology. This means that education is unable to produce students who are qualified and ready to compete. The application of technology in learning can be one solution in improving the quality of education. The quality of education has increased by applying advanced technology in learning to develop student learning outcomes. The application of technology in learning can be done by developing technology-based learning media, one of which is 3D holo-learning. 3D holo-learning learning media uses holograms as the technology used in learning. Holograms as a learning medium are able to visualize abstract material into concrete and adaptive ones. This research was conducted to develop 3D holo-learning as an interactive learning media for class XII high school students. The research method used is the ADDIE method. At the development stage, trials were carried out in small groups at high school on nervous system material. Based on the results of this trial, the learning effectiveness was quite effective at a percentage of 59%. The application was also carried out at the implementation stage for class.

Keywords: 3D hologram, science and technology based learning, nervous system.

Introduction

The birth of the era of society 5.0 has caused changes in various aspects of life. In this era, society must be able to solve various social problems caused by discoveries in the industrial era 4.0, namely artificial intelligence, internet of things, robot technology, and big data which of course can replace some of the need for human labor. It is hoped that these technological advances can be utilized to improve the quality of education in Indonesia.

Improving the quality of education can be done by implementing technology in learning. The use of technology-based interactive learning media is a form of technology integration in quality learning. The role of media as a meansof conveying information becomes more effective through integration with technology (Sulistiani et al., 2021).

Technology-based learning media is progress in delivering abstract material into concrete and adaptive to technological developments (Yanto, 2019). According to Minister of Education and Culture Decree No. 56 of 2022, technology-based learning media in learning in the independent curriculum is a flexible and contextual learning media.

The quality of education in Indonesia is still relatively low. According to the World Population Review, education in Indonesia is ranked 54th out of 78 countries, which is below Slovenia. According to the results of the PISA survey

ISSN 2829-3355 | EISSN 2828-8467

regarding secondary education systems in the world in 2019, Indonesia was in a low position, namely 74th out of 79 other countries in the survey (Kurniawati, 2022). Judging from the ranking results, Indonesia is ranked 6th from the bottom compared to the others. This position also shows that the quality of secondary level education in Indonesia is low. The low quality of education can affect the quality of human resources produced from schools in Indonesia (Kurniawati, 2022). The low quality of education can also be seen from the portrait of formal education in Indonesia which places more emphasis on generalist theory rather than application and specialization (IDRI, 2020). Learning with a generalist theoretical emphasis applies less technology in delivering the material. Another factor inhibiting improving the quality of education is the development of facilities and infrastructure in secondary level education (Kurniawati, 2022). This has an impact on the development of creativity and expertise in the field of science and technology which is not going well so that education has not been able to produce students who are qualified and ready to compete.

Developing facilities and infrastructure in the implementation of education is one way to improve the quality of education. Innovation in facilities and infrastructure can be done by implementing holograms in learning. This application is one of the learning media innovations by applying technology to improve the quality of education. Holograms utilize holography techniques to visualize the material taught in 3D (Nugroho & Purwanto, 2021). The use of holograms as a learning medium makes it easy to visualize abstract material into concrete. Concrete visualization provides increased student understanding of the material being taught (Armansyah et al., 2019).

Study This aim for developing 3D Holo-learning hologram- based visual media as interactive media high school students in increase quality Indonesian education. Development of 3D Holo-learning media is expected capable help student in increase understanding to material biology. The use of hologram visual media provides 3D visual depiction of material learning. Visuals provided in holograms too contains videos from material abstract that requires visualization in a way concrete. Holo-learning 3D hologram-based visual media is also expected can contribute active in advance quality education in Indonesia as one challenge development sustainable (Sustainable Development Goals) points 4th, namely Quality of Education.

Materials and Methods

Holo-learning visual media development research has several stages based on the ADDIE model. The use of the ADDIE model has 5 stages, including Analysis, Design, Development, Implementation, and Evaluate. The five stages above can be described in the following image (Figure 1.).

Figure 1. Stages of Research Implementation.

The analysis stage in the ADDIE model contains an analysis of the needs of teachers and students regarding the difficulty of the material taught in biology subjects and the learning media that has been used. Data collection was carried out by interviews at one of the SMA Negeri 1 Turen schools. Analysis also contains determining ideas from the results of interviews that have been conducted. The design stage is a continuation of the analysis stage by designing learning media from the ideas established in the analysis stage. The designs created include media design designs and planning plans for implementing Holo-learning visual media. The stages continue with the development stage which contains the creation of holo-learning media, learning guides with holo-learning, and validation results of materials and media. Various development results are used for the implementation stage by applying media and learning plans that have been developed in experimental classes and research classes. The data obtained from the implementation was tested at a further level of analysis to determine the effectiveness of learning and the influence of the use of learning media.

The subjects of this research were students of SMA Negeri 1 Turen, totaling around 45 students. The selected students were categorized into 10 class XII students and 35 class XI students who took biology subjects in the independent curriculum. Class XII students were used as a trial group for media developed in the development stage before proceeding to the implementation stage in class Data collection uses *pretest-posttest instruments* to measure student understanding. The data analysis technique used is the N-gain test to determine the effectiveness of the media in increasing students' understanding of the nerve cell material presented. The t difference test was also used to determine whether there was an increase in student understanding.

$$N - gain = \frac{posttest\ score - pretest\ score}{max\ score - pretest\ score} x100$$

Figure 2. N-gain score formula. Source: Archambault (2008).

Results and Discussion

Analyze

Based on the results of interviews with Biology teachers at SMAN 1 Turen, it was found that biology learning till lacks the use of media that is interesting to students. Biology learning still uses *Powerpoint media* and simple learning videos. Further interviews also showed that the nervous system material was the most difficult material in finding interesting media and able to make it easier for students to understand the material in learning.

" Nerves include subject matter that is considered difficult for students to understand due to its abstract depiction, so it requires learning media "

One of the teachers explained that the media for visualize cell nerves Still not enough is at its availability. So, learning biology with interesting media is less applicable and requires media for nervous system material.

Design

The 3D hologram learning media on the nervous system material is well designed and represents the structure of the nervous system in the material being taught in detail. Design 3D assets using attractive colors to attract students' attention. The color selection for each structure is different to make it easier for students to know the layout of each structure and the function provided by the structure. The products that have been developed can be seen in figure 3 below.

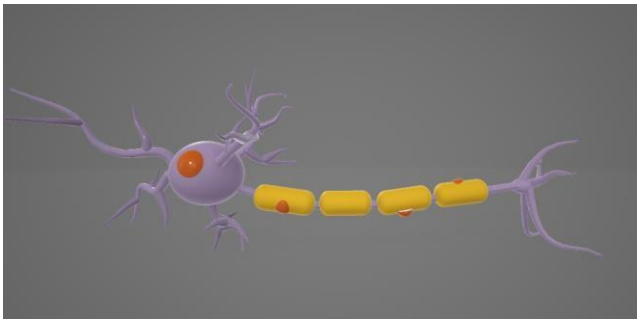

Figure 2. *Nerve Cell Hologram 3D Asset.*

Development (*Develop*)

The media that has been created in the design stage is carried out by developing learning tools and validating the entire tool. The learning tools developed using the *discovery learning model* use 3D hologram media as objects that will be used as material for student observation. Devices that have been created together with 3D hologram media are subjected to validation tests by experts. Validation results show that learning devices and 3D hologram media can used For tested on a small group of 10 class XII students who had taken nervous system material.

Table 1. Material Expert Validation Test.

No	Validator	Aspect	Mark	Category
1	First	Appropriateness fill	80	Very worthy
		Appropriateness presentation	75	Worthy
		Appropriateness Language	85	Very worthy
2	Second	Appropriateness fill	88	Very worthy
		Appropriateness presentation	93.3	Worthy
		Appropriateness Language	85	Very worthy

Table 2. Media Expert Validation Test.

No	Validator	Aspect	Mark	Category
1	First	Device soft	86.7	Very worthy
		Visual Communication	88.9	Very worthy
2	Second	Device soft	80	Very worthy
		Visual Communication	86.7	Very worthy

The validated devices and media are then applied in small groups. Small study groups are implemented in class XII of SMAN 1 Turen. Application in small study groups to obtain data that was tested for normality and homogeneity which can be seen in table 3 and table 4. The results of the normality and homogeneity test show that the data is homogeneous and normally distributed so that paired t-difference parametric tests can be carried out. Table 5 shows the results of the paired t-difference test showing a result of 0.000 which is less than 0.05, so it can be concluded that learning using 3D hologram media has an influence on student learning outcomes. The N-gain test was also carried out resulting in 59% which is included in the quite effective category.

Table 3. Normality Test Results with Shapiro-Wilk Small Groups.

Data		Shapiro-Wilk		
		Statistics	df	Sig.
Prepost	Pre- test	,897	15	,086
	post test	,921	15	,202

Table 4. Homogeneity Test Results with Small Group Levene Test.

	Levene Statistics	df1	df2	Sig.
Based on Mean	3,780	1	28	,062
Based on Median	1,578	1	28	,219
Based on Median and with adjusted df	1,578	1	18,333	,225
Based on trimmed mean	3,528	1	28	,071

Table 5. Results of the Small Group Paired Bed a T Test.

	Paired Differences				
	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre - Post	-29.78667	20.10891	-5,737	14	,000

Implementation

The application of 3D hologram media learning was continued in large classes for students who had never received this material. Sustainability is seen from the results of small groups which are able to improve student learning outcomes. The implementation was carried out in class XI Bio 7 at SMAN 1 Turen which contained 35 students. The data that has been obtained is tested for normality and homogeneity which shows that the data has a normal and homogeneous distribution in tables 6 and 7. The paired t-difference parametric test can be carried out by producing a value of 0.000 so it can be concluded that 3D hologram media has an influence on student learning outcomes as seen intTable 8. Learning effectiveness test using the N-gain test was also carried out to determine the learning effectiveness of 3D hologram media. The results of the N-gain test show that learning is considered quite effective in improving student learning outcomes with the resulting score being 59%.

Table 6. Normality Test Results with Shapiro-Wilk Large Groups.

	Group	Shapiro-Wilk Statistics	df	Sig.
Prepost	1.00	,954	28	,247
	2.00	,935	28	,084

Table 7. Homogeneity Test Results with Large Group Levene Test.

	Levene Statistics	df1	df2	Sig.
Based on Mean	,149	1	54	,701
Based on Median	,050	1	54	,823
Based on Median and with adjusted df	,050	1	51,416	,823
Based on trimmed mean	,126	1	54	,724

Table 8. Results of the Bed a T Test in Paired Large Groups

	Paired Differences		t	df	Sig. (tailed)
		Std. Deviation			
Pre -	-23.42857	17.28075	-7,174	27	,000

Discussion

This research aims to develop 3D holo learning media to make it easier for students to understand biology learning material. The implementation results in the implementation class show an increase in understanding of the nervous system material by using 3D holo learning media. Paired T-test analysis shows that there is a significant difference between the pretest and posttest with an average percentage increase of around 23.42% as well as the N-gain test which shows learning effectiveness of around 59%. The increase that occurred is in line with the results of research from (Sholiqah & Agustina, 2019) which shows that the effectiveness of learning using 3D media is more effective than without using this media. From the results of the paired T test, it can be seen that 3D holo-learning media is able to have a positive influence on biology learning, especially on nervous system material. The use of 3D holo-learning learning media which utilizes learning visualization is able to improve student learning outcomes in the cognitive domain by around 23.42%. A similar thing happened in the analysis of learning effectiveness which was included in the quite effective category. Learning with 3D holo-learning learning media provides effective student learning within 2 lesson hours (90 minutes) which is quite effective in improving student learning outcomes. Students look active in participating in learning using 3D holo-learning learning media. Learning by applying technology can be one way to activate student participation in learning (Mustaeva et al., 2022).

The use of learning visualization media has several advantages in improving students' understanding abilities. This advantage comes from students' visual learning style which makes it easier to understand the material. Visualization media also makes students' thinking, which previously considered the material irrational, become rational (Assa et al., 2019). The use of 3D hologram media in learning is the application of a learning style with the help of media that can visualize the material. Material visualization basically emphasizes how to learn more easily and increases students' interest in studying the material (Dewita et al., 2020). Learning with an appropriate learning style can also increase student motivation in participating in learning. Learning by using technology as an alternative in visualizing material can increase students' motivation in participating in learning (Puspitarini & Hanif, 2019). Increasing motivation can be one of the factors in improving student learning outcomes. Visualization media in learning also increases students' attention in learning. The visualization techniques used in 3D visual media can help activate parts of the brain and strengthen neural connections so that harmony and harmony will be created in the activities carried out by students. The harmony and harmony that is formed encourages students to focus attention and concentrate in learning (Khotimah et al., 2019). Student attention is a good reaction which results in increased student activity, concentration power, and limiting awareness to just one object (Nasib et al., 2020).

Conclusions

The development of 3D holo-learning learning media has had a significant influence in improving student learning outcomes. Learning delivered using 3D holo-learning media provides learning effectiveness which is categorized as quite effective in both groups, namely small groups and large groups. Improving learning outcomes through 3D holo-learning is achieved through visualization of abstract material to make it easier to understand the material provided. Learning by visualizing the material is included in the visual learning style which encourages students to be able to provide encouragement and interest in studying the material provided. Visualization of material also allows students to grasp the material rationally and be able to understand it well. The effectiveness obtained through 3D holo-learning only reaches the quite effective category due to lack of time for implementation. The time required for implementation needs to be increased to three lesson hours with 45 minutes in one lesson hour.

Conflict of Interest: The authors declare that there are no conflicts of interest concerning the publication of this article.

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