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THE UTILIZATION OF VIRTUAL REALITY ON DEVELOPMENT OF THREE DIMENSIONAL VISUALISATION ON CHEMISTRY SUBJECT

Ika Setiawati A. Bakar
Graduate School, Yogyakarta State University
Yogyakarta - Indonesia

K. H Sugiyarto
Faculty of Mathematics and Natural Science, Yogyakarta State University
Yogyakarta - Indonesia

Jaslin Ikhsan

Faculty of Mathematics and Natural Science, Yogyakarta State University
Yogyakarta - Indonesia

Abstract

The utilize of instructional media will assist the effectiveness of the learning process and the delivery of learning material. The development of 3D visualization media using virtual reality is done with the development model of Borg and Gall, namely from the stage of information gathering, the planning stage, the initial development stage, the initial trial phase, and the main product revision stage. Development of instructional media is validated by media experts, material experts, subject teachers, and tested it into the 25 students of State High School 2 of Ternate City. Validation results from experts and subject teachers receive eligibility in a positive category. 3D visualization media using virtual reality chemical equilibrium material is tested on students and the results obtained by appropriate learning media are in good category. The overall results of the validation of experts, subject teachers and trials for students gained an average percentage of 76%. So that it can be concluded that the development of 3D learning media using virtual reality is declared feasible as a learning media for chemistry learning of class XI activities on chemical equilibrium material.

Keywords: Media Development; Virtual Reality; Chemical Equilibrium.

INTRODUCTION

Growing information technology presents numerous innovations in various fields. Likewise in the education system that gets the impact of the development of information technology. In the world of education, forms of learning activities using information technology are arranged to assist in constructing concepts in learning. The world of education also began to prepare the delivery of material to students by using information technology capabilities, with the hope that the material delivered is capable to be easily understood by students and also can advance the quality of education especially in chemistry learning.

Chemistry is a subject that has abstract scientific studies (Effendy, 2002) and emphasizes the concept to microscopic (molecular) symbolic levels, and is classified as difficult subjects (Johnstone, 2000). Wu, Krajcik & Soloway (2000) also said that the ability of students to represent must be related to students' understanding of the basic concepts of chemistry. This makes many students have difficulty in connecting abstract concepts and make students feel difficult in studying chemistry. One of the chemical materials that requires representation ability is chemical equilibrium.

Karpudewan (2015) states that chemical equilibrium has a concept relating to submicroscopic events, so students must be able to represent it in the material. One of the sub-items in the equilibrium material is the factors that affect equilibrium is one of the chemical materials that requires a laboratory in the learning process, in accordance with its basic competencies, which is to investigate the factors that affect equilibrium by doing lab work in the laboratory. Laboratories in chemistry

learning in schools have functions such as to prove and develop concepts and theories, as a place to support class activities, conduct practicum, and a place to develop knowledge and skills (Herrani, 2015). Activities in the laboratory are also the most important part of chemistry learning, because it allows students to build their experience with concrete material. Karpudewan (2015) states that chemical equilibrium has a concept relating to submicroscopic events, so students must be able to represent it in the material. One of the sub-items in the equilibrium material is the factors that affect equilibrium is one of the chemical materials that requires a laboratory in the learning process, in accordance with its basic competencies, which is to investigate the factors that affect equilibrium by doing lab work in the laboratory. Laboratories in chemistry learning in schools have functions such as to prove and develop concepts and theories, as a place to support class activities, conduct practicum, and a place to develop knowledge and skills (Herrani, 2015). Activities in the laboratory are also the most important part of chemistry learning, because it allows students to build their experience with concrete material.

According to Tusiya (2011) the function of the laboratory is to provide completeness for accepted theoretical lessons, provide and foster the courage to seek the nature of scientific truths from an object in the natural and social environment, adding skills in utilizing tools. Laboratories are very important to make abstract chemical concepts become concrete and make chemical material easier for students to understand (Altun, et al, 2009). Tatli and Ayas (2010) state that one of the most efficient ways of learning chemistry is through laboratories. Based on the results of the study obtained if 87.8% of students revealed the deepening of chemical material can be obtained through the implementation of practical activities and 89.3% of students agreed that practicum activities can help improve the understanding of chemical material learned (Jahro. 2009). The practicum can also provide better results for increasing the absorption of students in the practiced material. In addition to improvement in learning achievement, practicum can also improve the scientific attitude of students.

Based on the results of observations, it was found that there were still many schools that had not used laboratories to support learning. This is due to the deficiency of availability of tools and materials in the laboratory, chemicals materials require very high costs and also some experiments are too risky for safety. As a result, most of the theories presented are difficult to prove. In general it can be said that the implementation of activities in the laboratory is very important in chemistry learning, but for some reasons this activity cannot be carried out properly. Therefore, an alternative laboratory or media environment is needed to assist students connect the experiments they need and make participants feel safe when carrying out dangerous experiments, observe every detail of the trial process, capable to play an active role in learning and can help students and teachers in anticipating the limitations of time, tools and materials according to the needs of students.

One way to help students understand the material in the laboratory of chemical equilibrium is through the medium of learning. Media that can be used are embodied learning media technology with three-dimensional (3D). Three-dimensional visualization technology was introduced using Virtual Reality (VR) which is used for chemistry learning. Three-dimensional technology using virtual reality can assist students to overcome problems such as the limitations of tools and materials as well as practicum to build cognitive abilities and scientific attitudes of students.

METHODS

Research methods

The learning media of three-dimensional visualization using virtual reality in this study was developed with reference to the development model of Borg & Gall (1983), adaptation and combination of Borg & Gall (1983) development models, Borg & Gall development models namely (1) information gathering; (2) planning; (3) initial product development; (4) initial trial; (5) product revisions

Data collection

The development model of Borg & Gall is adjusted to the research objectives used to develop three-dimensional media using the virtual reality development stage used in this study as follows. First is the stage of gathering information from various sources relevant to research on the development of three-dimensional learning media using virtual reality. At this stage of information gathering is done through library research and needs analysis. Second is planning, This plan was carried out with the aim of preparing instruments, media presentation models, simulating media and all related to three-dimensional media development using virtual reality. Third the initial product development stage is carried out with several steps including compiling chemical equilibrium material that will be loaded in the learning media, Making learning media design and Making learning media. Learning media is assessed by material experts and media experts. Material experts are chemistry lecturers who assess chemical equilibrium material. The aspects assessed are learning aspects and material with 10 indicators. Aspects assessed by media experts are audio visual and software engineering with 10 indicators. The virtual reality learning media was also assessed by 5 subject teachers. The aspects assessed are learning, material, audio visual and software engineering which consists of 20 indicators. Assessment carried out by material experts, media experts and teachers using a questionnaire with a Likert scale. Fourth is trial beginning, this stage tested media to obtain media readability assessment by 25 students who aim to get the analysis and consideration for product improvement. Fifth is product revision improvement based on the results obtained as well as input and discoveries obtained.

FINDINGS

The 3D visualization learning media with virtual reality on chemical equilibrium material through the development of this research can be accessed using Android. This learning media can be used as a substitute or supplement to experimental activities in a real laboratory. The initial page of 3D visualization media application with virtual reality can be seen in Figure 1 below.

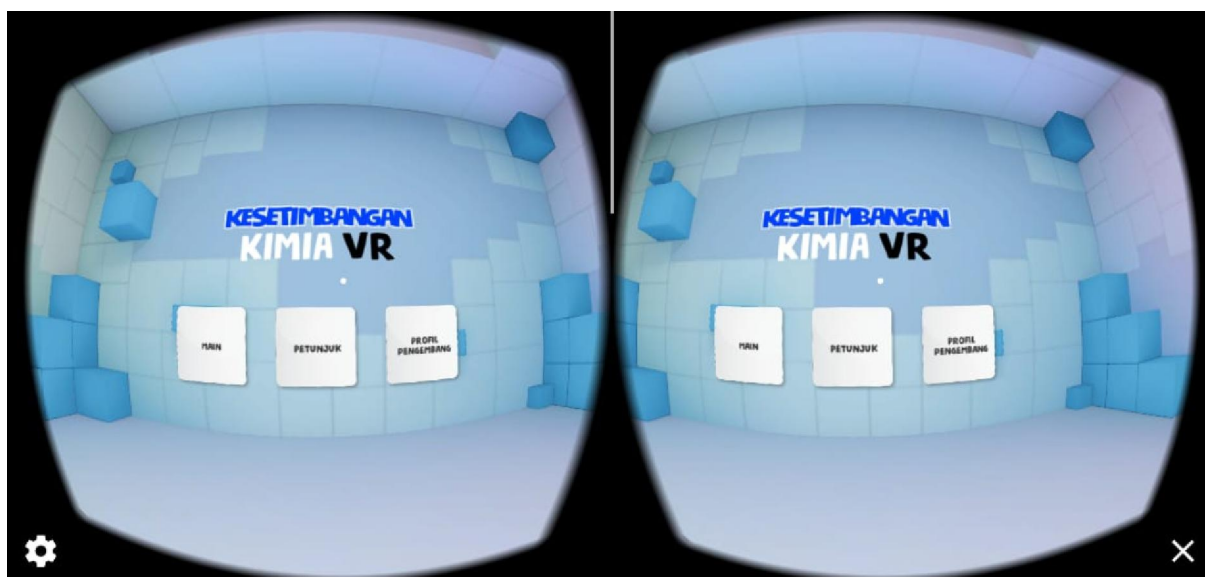


Figure 1: Home Display

Each experiment is equipped with an experimental procedure with a view instructions can be seen in Figure 2. Each user can perform a simulation lab experiment with selecting tools according to the procedure.

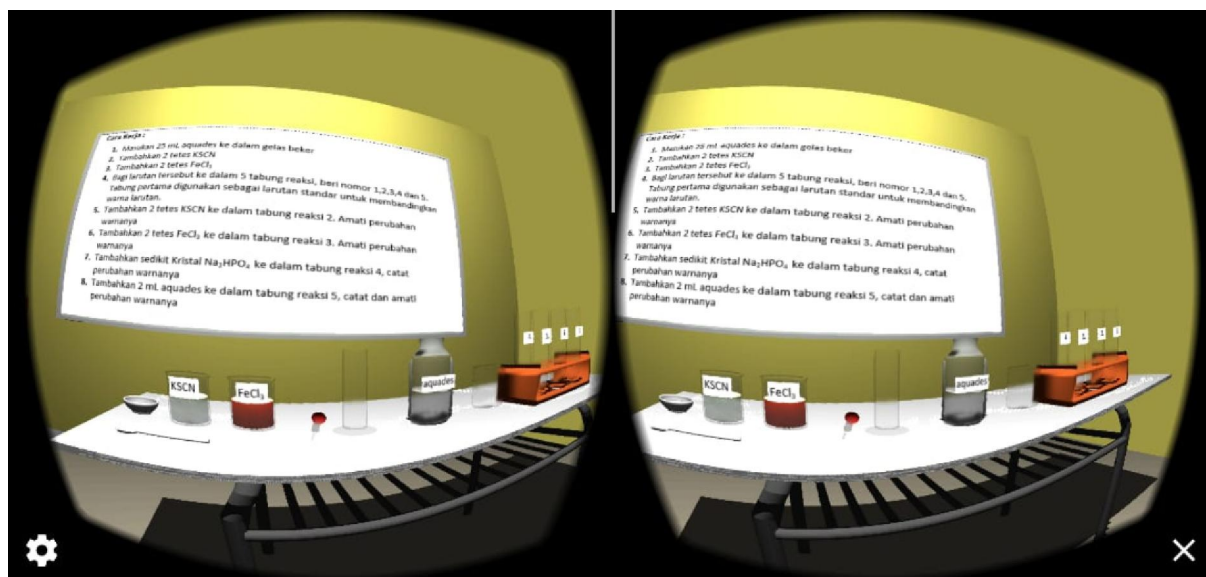


Figure 2: Experiment Display

Product Development Results

The study used 3D visualization media with virtual reality in chemical learning containing chemical equilibrium lab simulation. Data obtained from material experts, media experts, teachers and students were analyzed by calculating formulas and adjusted to the media eligibility criteria as found in Table 1.

Table 1: Criteria for Media Quality Categories

No	Score Range	Category
1	$\bar{X} > \bar{X}_i + 1,8 Sb_i$	Excellent (SB)
2	$\bar{X}_i + 0,6 Sb_i < \bar{X} \leq \bar{X}_i + 1,8 Sb_i$	Great (B)
3	$\bar{X}_i - 0,6 Sb_i < \bar{X} \leq \bar{X}_i + 0,6 Sb_i$	Sufficient (C)
4	$\bar{X}_i - 0,6 Sb_i < \bar{X} \leq \bar{X}_i + 0,6 Sb_i$	Bad (K)
5	$\bar{X}_i - 1,8 Sb_i < \bar{X} \leq \bar{X}_i - 0,6 Sb_i$ $\bar{X} \leq \bar{X}_i - 1,8 Sb_i$	Poor (SK)

The data obtained is used as a basis for determining the feasibility of 3D visualization media with virtual reality developed. Data in the development of 3D visualization media with virtual reality in the form of a general assessment of 3D visualization media with virtual reality developed from media experts, material experts, teachers and the opinions of students. The results of the 3D visualization media validation with virtual reality by experts can be seen in Table 2.

Media Assessment from Experts, Teachers and Students

Table 2: Media Assessment from Experts

No	Aspect	Grade	Category
1	Learning Aspect	3,8	Great
2	Material Aspect	3,8	Great
3	Audio Visual Aspect	3,7	Great
4	Software Engineering Aspects	4.5	Excellent

The results of the validation from the material experts focused on the learning aspects and material aspects and for media experts focused on audio visual aspects and software engineering aspects. The

quality of media from experts with an average of 3.95 demonstrates that the overall quality of the media from experts is categorized as great. The initial media products after being validated by experts were then validated by subject teachers. Aspects assessed by subject teachers are aspects of learning, material aspects, audio visual aspects and software engineering aspects. Aspects assessed by chemistry teachers with an average of 3.86 are included in the great category. Media assessments by subject teachers are listed in Table 3. below.

Table 3: Media Assessments from Teachers

No	Aspect	Grade	Category
1	Aspect Learning	3,72	Great
2	Material Aspect	3,68	Great
3	Audio Visual Aspect	3,7	Great
4	Software Engineering Aspects	4,35	Excellent

Media products after being assessed by experts and subject teachers, the assessment was also carried out by students including learning aspects and materials as well as audio visual aspects and media operations. The trial involved 25 students to use 3D visualization media with virtual reality and assess the media. Results of the assessment of media by the learner can be seen in Table 4. The results of the assessment test had an average value of 3.7 included in both categories.

Table 4: Media Assessment of Students

No	Aspect	Grade	Category
1	Learning Aspect and Material Aspect	3,52	Great
2	Display Aspect and Operational Media	4,01	Great

DISCUSSION AND CONCLUSION

The process of developing 3D visualization media with virtual reality was carried out by researchers based on the Borg and Gall development model with 5 stages, namely information collection, planning, initial product development, initial trials and major revisions.

In the stage of gathering information, the researcher gathered information about the media for learning 3D visualization with virtual reality and needs analysis. The curriculum used in State High School 2 of Ternate City is the 2013 curriculum. In addition to the curriculum researchers also review syllabi and indicators for chemical equilibrium material.

The planning stage, in planning the researcher prepares the media presentation model, makes the objects contained in the media and simulates media in accordance with the chemical equilibrium practicum in the real laboratory.

The initial development after learning media was designed, then 3D visualization media with virtual reality was validated by media experts and material experts to produce 3D visualization products with virtual reality. After that the learning media is given to subject teachers to be assessed and declared good to enter the initial trial stage. The initial trial was conducted by 25 students of Ternate State High School 2 High School.

Based on the results of the validation of the experts in Table 2. The results of media readability from the learning aspects and material aspects obtained great categories with a percentage of 76%, for the audio visual aspects of the good category with a percentage of 74% and software engineering aspects have a percentage of 90% with excellent categories. The results of 3D visualization media validation with virtual reality obtained an average percentage of 79%, then the development of 3D

visualization learning media with virtual reality was declared feasible as a chemical learning media for chemical equilibrium material.

Based on Table 3. The results of the validation of subject teachers observe from the aspect of learning included in the good category with a percentage of 74.4%, the material aspect has a percentage of 73.6% which is included in the great category, for the audio visual aspect the category is 74% and aspects software engineering has a percentage of 87% with an excellent category. The results obtained have an average percentage of 77.2%, the development of 3D visualization media learning media with virtual reality is declared feasible as a chemical learning media for chemical equilibrium material.

The results of the initial trial based on the opinions of students can be observed in Table 4. From the results of the assessment for aspects of learning and material included in the great category with a percentage of 70.4% and the appearance and operational aspects of the media has a percentage of 80.2% which is included in the great category. The results of the initial 3D visualization media using virtual reality obtained an average percentage of 74%, then the development of 3D visualization learning media using virtual reality was expressed as both a chemical learning media for chemical equilibrium material.

The overall results of 3D visualization media validation using virtual reality obtained an average percentage of 76%, the development of 3D visualization media using virtual reality was declared feasible as a chemical learning media for chemical equilibrium material. This result is supported by Riduwan (2011) which states that learning media can be said to be feasible if the average percentage of expert validation questionnaires, teachers and student responses is above 61%.

The use of 3D visualization media learning technology using virtual reality in learning makes participants more interested. In addition, it can improve learning and make learning more effective, increase the experience of students and also provide practical needs of students (Garrison and Akyol, 2009). The ability to create a variety of environments has made the virtual 3D world useful for reducing peril in science laboratories. Practical simulations in learning media help students who experience difficulties in learning (Urso & Fisher, 2015). Cerniglia (2011) says that learning must be done more creatively so that it can help students. 3D visualization using virtual reality makes students feel as if they are in a real laboratory. Students are more motivated in learning using a 3D virtual environment. The use of information, communication and technology can be a good opportunity to create chemical learning programs with effective tools to develop new methods and techniques in educational programs (Pekdag, 2010).

The development of 3D learning media using virtual reality consults to the development model according to Borg and Gall, which in this study only carried out several stages, namely the stage of information gathering, the planning stage, the initial development stage, the initial trial phase and the product revision stage. 3D visualization media using virtual reality that has been developed is feasible to be used as a learning media for chemical learning activities, namely chemical equilibrium based on the assessment carried out by media experts, material experts, teachers and students with a percentage of 76%.

Learning media becomes integral to teaching. In this modern era, learning media is certainly easy to obtain, but the media must also reach out to all students and be an alternative solution to students' lack of enthusiasm for learning. The technology developed using virtual reality environments can be used as an effective learning media, increasing student and interactive involvement. 3D visualization media using virtual reality can also help students who are still passive when in a real laboratory and can be an opportunity for future chemical learning media.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



Ika Setiawati A. Bakar is a student of Chemistry Department, Graduate School, Yogyakarta State University, Indonesia. Her interest of researcher are media development and implementation of media in chemical learning

Ika Setiawati A. Bakar, S.Pd
Graduate School, Yogyakarta State University
Yogyakarta - Indonesia
E. Mail: ikasetiawati68.2017@student.uny.ac.id ; setiawatyika68@gmail.com



K.H. Sugiyarto is a lecturer and researcher in Chemistry Department, Faculty of Mathematics and Natural Science, Yogyakarta State University, Indonesia. His research interests educational media development in chemistry teaching learning, misconception observed in chemistry textbooks and users, students, and teachers.

Prof. Dr. K.H. Sugiyarto M.Sc.,Ph.D
Department of Chemistry Education, Faculty of Mathematics and Natural Sciences
Yogyakarta State University
Yogyakarta – INDONESIA
E. Mail: sugiyarto@uny.ac.id



Jaslin Ikhsan is a lecturer and researcher in Chemistry Department, Faculty of Mathematics and Natural Science, Yogyakarta State University, Indonesi. His interest researcher are educational media development in chemistry teaching learning and has been uploaded in playstore in the title of chemdro.

Drs. Jaslin Ikhsan M.App.Sc.,Ph.D
Department of Chemistry Education, Faculty of Mathematics and Natural Sciences
Yogyakarta State University
Yogyakarta – Indonesia
E. Mail: jikhsan@uny.ac.id

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