DEVELOPMENT OF VIRTUAL LABORATORY ON REACTION RATE MATERIALS TO IMPROVE STUDENTS' SCIENCE PROCESS SKILLS

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Abstract. *This research aim to produce a Multimedia Virtual Laboratory on the Reaction Rate Material to train Science Process Skills on the sub-materials of factors that affect reaction rates. The research method used is Research and Development (R&D). The results of the content validation was 91.67%, construct validation was 97.23%, validation related to presentation was 97.23%, validation related to language was 95.84% with very valid criteria. The results of the student response questionnaire stated that the average percentage of responses was 91.25% which could be categorized very practice. The results of the pre-test and post-test scores based on the t-test obtained the value of Sig. (2-tailed) 0.00 < 0.05, as well as the N-Gain analysis score of 0.93 > 0.7 with a high category which could be categorized very effective so that it can be concluded that the virtual laboratory interactive learning multimedia is feasible to use based on the feasibility of validity, practicality, and effectiveness and can used to train students' science process skills.*

Keywords: *Interactive Multimedia, Virtual Laboratory, Science Process Skills*

INTRODUCTION

Education is the key to the success and progress of a nation. In facing the current of globalization, developments in the field of education must be balanced with sciences dan tecnology [1]. Educators must have in-depth practical knowledge of students, be able to convey effective learning, attract students' interest, and be able to master strategies to increase students' understanding of concepts [2]

Chemistry learning is a science group whose activities require experimentation. Materials that studied on chemistry is the reaction rate. The rate of reaction of a material is one of the materials that requires a learning process through practicum activities. However, there are several obstacles in carrying out practical work in the laboratory, including: the absence of an adequate laboratory, the absence of laboratory assistants, incomplete laboratory equipment and materials, and lack of knowledge about hazardous chemicals so that they are considered something dangerous [3].

In facing the globalization era, developments on the field of education must be in harmony with the latest developments in science and technology which are increasingly sophisticated and up-to-date. The knowledge and technology that students receive is of course obtained from professional educators.

Visualization during learning is very necessary for students so that students can understand the material thoroughly. This can be done through experiment both in people and virtually. One of the branche of science is chemistry. Chemistry is one of science that is related to our life, so it is very important for students to study and explore it. Chemistry learning is a science family where activities require experiments. Thus, the existence of laboratories and other practicum support becomes very important in the process of increasing students' understanding of learning. Regardless of the implementation of practicum and conditions in the learning process, education can continue to be carried out without

having to wait for the completeness and readiness of laboratories and their supports. In addition, in improving science process skills, experiments / practicums must be carried out periodically which can be done anytime and anywhere so that students can master these skills. Therefore, innovation is needed in overcoming the limitations of the laboratory, one of which is the development of a virtual laboratory.

In fact, learning in schools is still too monotonous with makeshift learning media so that it becomes an obstacle in increasing students' understanding. Based on the results of questionnaire data regarding concept comprehension from 36 class XII students at SMAN 8 Surabaya during the pre-research, it was stated that 97.22% of students said they could translate well, 94.44% of students said they could interpret well, 72, 33% of students said they could extrapolate well. However, data from the concept comprehension test during the pre-research, the 36 students did not support the results of the questionnaire obtained. The percentage of the average score obtained by students for each component of understanding the concept is the ability to translate 40.12%, the ability to interpret 34.41%, the ability to extrapolate 28.01%. This result is still very low from the criteria so there is a need for learning innovation to improve science process skill of students.

The use of interactive learning media such as virtual laboratories on reaction rate material as a means of supporting the teaching and learning process in schools is still very limited. This can be seen from the various examples of virtual laboratories that have developed at this time, such as the virtual laboratory by the Ministry of Education and Culture, there is still no practicum simulation on the sub-matter of factors that affect reaction rates. It can be seen that the limitations of using technology in learning are still very minimal and there are still many educators who have not been able to develop computer-based learning media Based on research, science process skills can be improved by learning using a virtual laboratory basis. In this study, it was obtained that the percentage (%) of pretest indicator achievement was 24.08% in the very poor category, but after learning using a virtual laboratory, it was obtained that the percentage (%) of indicator achievement in the posttest was 81.64% in the good category [4].

However, the development of a virtual laboratory on the submatter of factors that affect the reaction rate is very rare and the current virtual laboratory still cannot provide a real visualization of the reactions that occur in it. Based on research conducted by Judges who used virtual laboratory interactive media (PhET) stated that the implementation of learning by application of a virtual laboratory (PhET) as a highly interactive learning medium on reaction rate material using a direct teaching model was stated to be good with a percentage of 74.46% [5].

Student activity in teaching and learning activities through the application of vlab learning media on PhET on the reaction rate material was stated to be high. Student learning outcomes after learning by applying virtual laboratory learning media (PhET) on the reaction rate material with the direct teaching model show that there is a difference in the average value before and after learning. However, there was no difference in changes in the learning progress of the experimental class and the control class. In the virtual laboratory learning media (PhET) each factor that affects the rate of reaction is not classified so that it becomes difficult for students to conclude the results of each factor that affects the rate of reaction. It can also be seen that the limitations of using technology in learning are still very minimal and there are still many educators who have not been able to develop computer-based learning media [6].

Based on the existing virtual laboratory, a virtual laboratory will be developed with sub-factors that influence the rate of reaction with experiments that focus on each sub-factor so that it can make it easier for students to understand each of the factors that exist. In addition, facilities will be provided in the form of introductory material, guides, and information about the skills students will acquire, namely science process skills (KPS) so that students know the purpose of conducting the experiment. Therefore, the development of virtual laboratory interactive learning media is urgently needed so that it can help make the teaching and learning process more interesting and can improve students' science process skills.

A virtual laboratory is a medium that contains interactions and experiments via computers [7]. The aim of this study was to obtain a feasible virtual multimedia laboratory based on the criteria of validity, practicality, and effectiveness. In this research, the virtual laboratory developed is a virtual laboratory on the factors that influence the rate of reaction. The use of virtual laboratories can make students have a better understanding by means of virtualization through applications or the web with methods that are more economical and easily accessible anytime and anywhere [8].

Based on the description of the background above, the writer intends to develop a virtual laboratory as an interactive learning medium on reaction rate material to improve concept comprehension of class XI students.

METHOD

The research method used is the Research and Development (R&D) research method. The research model used in this study is the 4D research model [9].

The limited trial was tried on 10 students of class XII SMAN 8 Surabaya who were selected heterogeneously with the aim of knowing the student's response to the learning tools developed. This trial was carried out using a one group pre-test and post-test design, where before being given the learning tools students, then after being given learning with the tools that had been developed students were given a post-test.

The research instruments used were validation sheets, student response questionnaires, and learning outcomes test sheets. The feasibility of virtual laboratory multimedia is obtained from the analysis of validity, practicality, and effectiveness.

Validity

The percentage of validation data obtained by the Likert Scale as in this table.

Table 1. Likert Scale for Validity

Crieria	Score
Very bad	1
Bad	2
Good	3
Very good	4

[10]

The percentage results are used to determine the validity of the interactive learning media used by using a score interpretation as follows.

Tabel 2 Interpretasi Skala Likert

Percentage	Criteria
25% - 40%	Very bad
41% - 60%	Bad
61% - 80%	Good
81% - 100%	Very good

[10]

Based on these criteria, interactive learning media is said to meet the criteria if the percentage result is more than equal to 61% so that it is valid to be used in the learning process.

Practicality

The percentage of research data that has been carried out based on the Guttman Scale is described in table 3.

Table 3. Guttman Scale

Question	Answer	Score
Positive	Yes (Y)	1
	No (N)	0
Negative	Yes (Y)	0
	No (N)	1

[10]

The percentage results are used to determine the practicality of interactive learning media used by using the interpretation of scores as follows.

Table 4. Interpretation of Score

Percentage	Criteria
25% - 40%	Very bad
41% - 60%	Bad
61% - 80%	Good
81% - 100%	Very good

[10]

Based on these criteria, interactive learning media is said to meet the criteria if the percentage result is more than equal to 61% so that it is practically used in the learning process.

Efectiveness

The effectiveness criteria in the developed virtual laboratory are evaluated based on the

test scores of students' learning outcomes. The test data for student learning outcomes were obtained from the results of the pre-test and post-test. The results of the pretest and posttest were used to calculate the normalized gain (N-Gain). Before calculating the N-Gain value, the student data was tested for normality first. The data can be said to be normally distributed if the significance value is more than 0.05 (α 0.05). After the data is declared normally distributed, then the N-Gain value can be calculated. The N-Gain value shows an increase in students' conceptual understanding after learning is carried out. N-Gain can be calculated by the equation:

$$\text{Gain} = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

N-Gain level criteria are shown in the following table:

Table 5. Interpretation Score of N-Gain

Percentage	Criteria
G ≥ 0,7	High
0,3 ≤ G < 0,7	Medium
G < 0,3	Low

[10]

Based on the N-Gain criteria, interactive learning media can be said to be effective if the results of increasing student learning have the average Gain score obtained reaching the "medium" or "high" criteria.

RESULT AND DISCUSSION

Development of Virtual Laboratory as Multimedia Innovation for Interactive Learning on Reaction Rate Materials to improve Students' Science Process skills was tested on 10 students at SMAN 8 Surabaya on September 23, 2022. This trial was used to determine the Virtual Laboratory multimedia based on aspect validity, practicality, and effectiveness.

Validity

The validation process uses a validation instrument and the validation results are obtained as follows:

Table 6. Result of Validity

Component	Percentage	Criteria
Content	91,67%	Very Good
Construct	97,23%	Very Good
Presentation	97,23%	Very Good
Language	95,84%	Very Good

Based on the recapitulation data from the validation results in the table above, the results of the content feasibility are 91.67% with very valid criteria. This means that the scope of the feasibility of the content of the material contained in the Virtual Laboratory multimedia is in accordance with the criteria with the learning objectives of the reaction rate material and the dimensions of science process skills. The feasibility of the Virtual Laboratory multimedia content includes 4 things, namely: (1) the suitability of the material in the virtual laboratory with learning indicators, (2) the consistency of the systematic presentation of the material in the virtual laboratory, (3) clarity in the presentation of the material in the virtual laboratory, (4) the conformity of the items. questions to be tested with learning indicators.

The construct validity aims to determine the suitability between the substances administered in the multimedia Virtual Laboratory with indicators of science process skills. In the recapitulation table of the validation results, the results of the feasibility of the Virtual Laboratory multimedia construct are 97.23% with very valid criteria. This can indicate that the Virtual Laboratory multimedia has contained the compatibility of the Virtual Laboratory's multimedia design with the components in it, the ease of users accessing the Virtual Laboratory's multimedia, and the harmony between the colors of the text, background, and images. The following is a display of the virtual laboratory simulation menu.

Figure 1. Stage on Concentration Factor

Figure 2. Stage on Surface Area Factor

Figure 3. Stage on Temperature Factor

Figure 4. Stage on Catalist Factor

The validity of the Virtual Laboratory multimedia presentation that was developed got a result of 97.23% with very valid criteria. This states that the Virtual Laboratory multimedia developed is coherent, systematic, and interactive as a learning medium. The validity of the Virtual Laboratory multimedia presentation includes three factors, including: (1) the features in the Virtual Laboratory multimedia support learning activities, (2) the ease of use of the Virtual Laboratory multimedia, and (3) complete and clear instructions for using the Virtual Laboratory multimedia.

The Language validity of the developed Virtual Laboratory multimedia obtained a result of 95.84% with very valid criteria. Language is one of the important keys in learning chemistry. The use of appropriate language can affect the success of students in understanding a material.

Practicality

The practicality test phase was used to obtain practical data from the virtual multimedia laboratory through a student response questionnaire which was filled out by students after using the developed media. The developed media is said to be feasible if the percentage results are more than equal to 61% so that it is practically used in the learning process. The average student response recapitulation is as follows:

Table 7 Response Questionnaire Results

Component	Percentage	Kriteria
Content	90%	Very good
Presentation	90%	Very good
Language	95%	Very good
Graphic	90%	Very good

The results of the practicality of the Virtual Laboratory multimedia with an overall average of 91.25% with each component percentage 81% which can be categorized as a multimedia Virtual Laboratory developed very practical.

Effectiveness

At this stage using the pretest and posttest sheet instruments consisting of cognitive tests and skills tests. In the cognitive test, the questions are in the form of multiple choices with 5 answer options and the number of questions is 10 questions related to the sub-material factors that affect the rate of reaction. In the skills test there are 7 questions related to science process skills in the form of questions, namely descriptions.

Normality Test was performed using the IBM SPSS Statistic 26 application. Based on table 4.3. The sig. for the pretest is 0.923 and for the posttest is 0.169. From these data it can be said that the pretest and posttest scores were normally. After the data is declared normally distributed, it is continued with the calculation of N-Gain. obtained the following results.

Tabel 4.5 N-Gain Score

Pre-test	Post-test	N-Gain	Criteria
28,57%	95,71%	0,95	High

Based on table 4.5 the N-Gain score shows 0.95, meaning that the N-gain score 0.7 with a

high category so that it can be said that the Virtual Laboratory multimedia developed is effectively used to train students' science process skills.

CONCLUSION AND RECOMENDATION

Conclusion

Based on the results of research and data analysis, the potential results of this research are that the multimedia Virtual Laboratory meets the eligibility criteria and can train science process skills in terms of:

1. Validity score with a score of 91.67% for content criteria, 97.23% for construct criteria, 97.23% for presentation criteria, and 95.84% for linguistic criteria with a very valid category.
2. The student response score is 91.25% with a very practical category.
3. Analysis of the results of the N-gain test score of 0.95 with a very effective category.

So it can be concluded that the multimedia Virtual Laboratory meets the eligibility criteria and can train science process skills in terms of validity, practicality, and effectiveness.

Recomendation

Advice from researchers in this study is that the development of further research can be further deepened with case study methods and trials to a wider range of respondents so that the results obtained are more valid and reliable.

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