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Ethnoscience-Based Interactive Multimedia to Improve Scientific Literacy in Chemical Equilibrium Materials

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Abstract
This study aims to obtain interactive multimedia that can improve scientific literacy skills in chemical equilibrium material. The method used in this research is the Borg and Gall Research and Development (R&D) model with three stages, namely the preliminary study stage, the media development stage and theoretical validity, and the media trial stage. The trial design used was one group pretest posttest. The data obtained was in the form of a validity score determined by the mode, the practicality score from the results of the student response questionnaire was analyzed by percentage, and the effectiveness data in the form of pretest-posttest results were analyzed using n-gain. Based on the results of the study, the validity mode was obtained, namely a score ≥ 3 in each aspect, a practicality score of 94,4%, an n-gain score of 0,8088 in the high category, and classical completeness of 91,43%, so that ethnoscience-based interactive multimedia can be declared feasible. to improve scientific literacy skills on chemical equilibrium material.

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INTRODUCTION

Education in the 21st century is in harmony with technological advances which are quite rapid in the era of society 5.0. in this case, education plays a role in social sustainability, both in cultural transformation and creating tools of social control (Sujana, 2019). Education is also required to be able to present students who are able to think critically, constructively, and innovatively. Student competencies that need to be developed to meet these expectations are critical thinking, reasoning, creative, communicative, collaborative, and have the ability to solve problems. (Adirilany et al., 2023).

The 2013 curriculum is expected to be able to face the challenges of the 21st century and become an alternative in improving the quality of learning (Istiqomah, 2018). This hope is also in line with the expectations of the independent curriculum which states that chemistry can produce innovation in learning (Permendikbud, 2019). In improving the quality of science learning in schools, it is necessary to pay attention to the achievements of scientific literacy based on its aspects (Nurwanti, Khery, & Nufida, 2018). However, based on the results of the 2018 Program for International Student Assessment (PISA) survey, Indonesia is still in 71st place out of 79 countries (OECD, 2019).

Science essentially consists of a product and process that are interrelated with facts, concepts, principles, theories, and laws. The two components of science are contained in chemistry

which has the characteristics of an abstract concept and is continuous with everyday life (Adytia & Dwiningsih, 2018). Chemical balance is one of the chemical materials that is abstract in nature and has a fairly high level of difficulty for students. Chemical equilibrium material is considered difficult by students because it includes three representative levels of chemistry, namely macroscopic, sub-microscopic, and symbolic. (Agatha et al., 2022). In one study it was found that students' scientific literacy in chemical equilibrium material was low with the percentage of each scientific literacy competency still below 50% (Narestifuri & Hidayah, 2021).

The low scientific literacy in Indonesia is thought to be due to the lack of attention to the socio-cultural environment as a source of learning which makes it one of the problems of education in Indonesia (Imansari et al., 2018). Students can more easily understand chemical concepts or material and improve conceptual learning by using local cultural approaches as science learning objects (Andayani et al., 2021).

Ethnoscience is the study of scientific knowledge that involves the environment and culture of society (Roziqin et al., 2019). However, there are still not many who implement the ethnoscience approach in learning. Learning with an ethno-science approach plays an important role in education as a form of communication and expression of a development of knowledge and ideas about local culture and wisdom of an area (Utari et al., 2020). In addition, many of today's young people do not know the culture and local wisdom of the area where they live, which generally occurs in big cities such as the city of Surabaya. This is because Surabaya, which is known as a city of heroes with increased industrial, trade and service activities, has made the city of Surabaya a destination for increased urbanization. The large number of people urbanizing the city of Surabaya causes socio-cultural phenomena that tend to be negative (Basuwendro, 2016). Learning with an ethnoscience approach can be used as an effort to maintain local wisdom owned by the City of Surabaya.

The most important component in learning is the interaction between educators and students in the teaching and learning process. The use of learning media can improve student learning outcomes. Good learning media must be interesting and able to develop students' interests, according to the characteristics, learning styles, and learning objectives (Lutfi, 2017). The use of digital technology in learning can be done using interactive multimedia. Interactive multimedia is a combination of various media that can lead to two-way communication or more (Lestari et al., 2021). Multimedia technology that is integrated with the learning process is recognized as increasingly capable of adding value to educational applications (Setiawan et al., 2017). Ethnoscience-based interactive multimedia can make it easier for students to understand material and be involved in using technology during learning so that they can be more active and creative.

Based on these research problems, it is necessary to conduct a feasibility test which includes the validity, practicality, and effectiveness of ethnoscience-based interactive multimedia to improve scientific literacy skills in chemical equilibrium material.

METHOD

The research method used is Research and Development (R&D) Borg and Gall which has three stages including the preliminary study stage, the media development stage and theoretical validity, and the media trial stage. (Sukmadinata, 2020). In the media trial phase, it was carried out only up to limited trials

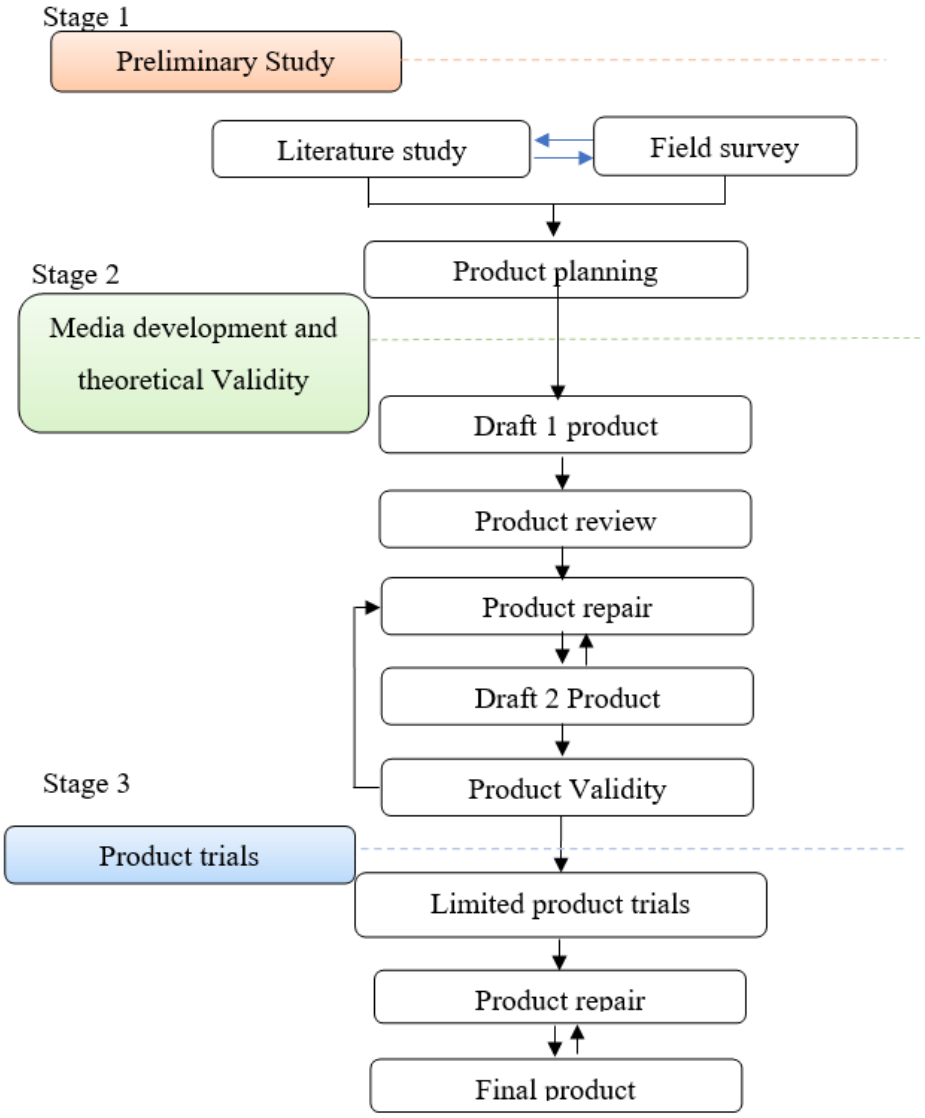

Figure 1. Borg And Gall Development Stages

This study used a pre-experimental trial design with One Group Pretest-posttest Research Design (Cresswell, J. W., and Cresswell, J. D., 2018).

O_1	X	O_2

Figure 2. Media Trial Design

Information :

O_1 = Pretest results

X = Research Treatment

O_2 = Posttest results

Data collection techniques in this study were questionnaires and tests. The questionnaire used in this study included a validity questionnaire and a student response questionnaire. The validity questionnaire is used to determine the validity of the developed interactive multimedia. The validators in this study consisted of three media and chemistry experts. Completion of the validity questionnaire uses a modified Likert scale to obtain more accurate research data and prevent the possibility of a tendency to answer to the middle answer. The following is a modified Likert scale score used.

Table 1. Modification of the Likert Scale Score

Statement	Score
Invalid	1
Not enough valid	2
Valid	3
Very valid	4

(Dewi & Ramantha, 2016)

The validation data is in the form of ordinal data which can be analyzed by determining the mode for each aspect or indicator with the condition that the mode score is ≥ 3 to be declared valid for that aspect. If there are aspects that do not meet the valid requirements, they must be revised and re-validated until they reach the specified criteria (Lutfi, 2021).

Student response questionnaires were used to find out the practicality of ethnographic-based interactive multimedia used in learning. Analysis of student response questionnaire data using the Guttman scale in the form of questions.

Table 2. Statement Scores based on the Guttman Scale

Statement	Positive Statement Score	Negative Statement Score
Yes	1	0
No	0	1

(Riduwan, 2016)

Score of positive statements. Score of negative statements. Student responses to the use of interactive media developed in each aspect are calculated using the following formula.

$$\text{Percentage of student scores } (\%) = \frac{Sum\ of\ Score}{Maximum\ score} \times 100\%$$

The percentage of student scores is calculated on average with the following formula

$$\text{Percentage of average score } (\%) = \frac{\text{Sum of Percentage of student scores } (\%)}{Number\ of\ Students}$$

The results of the analysis of student responses are known by their categories based on the following table.

Table 3. Practicality Score Interpretation Criteria Based on the Likert Scale

Average Score (%)	Category
0-20	Very less
21-40	Not enough
41-60	Enough
61-80	Good
81-100	Very good

(Riduwan, 2016)

The tests conducted in this study were in the form of a pretest and posttest which contained 10 scientific literacy questions on chemical equilibrium to determine the effectiveness of interactive multimedia used in learning. The data in this study were in the form of quantitative data obtained from pretest-posttest scores, N-gain which were statistically analyzed using SPSS 25, and classical completeness calculations. The N-Gain calculation results can be grouped into the following categories (Table 4). Student learning outcomes can be said to increase and interactive multimedia is categorized as effective if the N-Gain value (<g>) ≥ 0,3.

Table 4. N-Gain Score Category

Index Gain	Category
<g> > 0,70	High
0,30 ≤ <g> ≤ 0,70	Medium
0,30 > <g>	Low

(Hake, 2002)

The calculation of classical completeness is carried out from the data from the posttest results of students. In determining the completeness of students, it is necessary to have a National Maximum Completeness Criteria (KKM) score to be declared complete, namely with a value of ≥ 75 (Hidayat et al., 2020). Furthermore, from the completeness of students, mastery can be calculated classically and analyzed using percentages. Product development can be said to be effective if classical completeness reaches ≥ 75% (Larasati et al., 2021). Interactive multimedia that has been developed can be declared feasible if it meets valid, practical, and effective criteria.

RESULTS AND DISCUSSION

Preliminary Study Stages

At the preliminary study stage, a literature study and field survey were carried out to find out problems related to the media product to be developed. Literature study is carried out by reviewing relevant studies in national and international journals. Furthermore, a field survey was conducted to find out the basic problems in learning chemistry by distributing questionnaires and interviews. The results of the questionnaire during the field survey at State Senior High School (SMAN) 8 Surabaya obtained 57.1% of students who found it difficult to understand the sub-material of the factors that influence the shift in the direction of equilibrium.

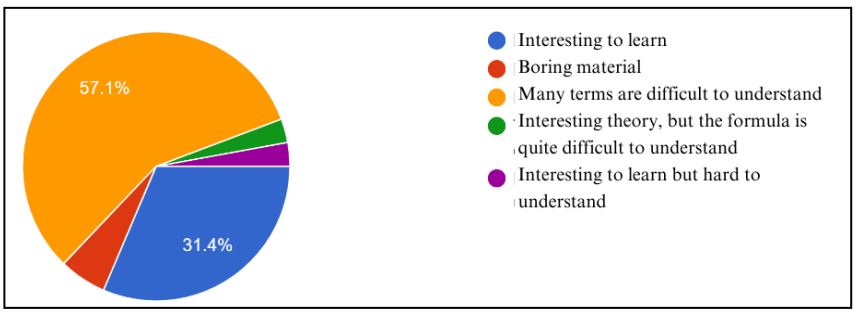

Figure 3. Field Survey Questionnaire Results

The results of interviews with students also show that students still find it difficult to distinguish between factors that affect the direction of a shift in equilibrium and factors that affect reaction rates. The results of the chemistry teacher interview showed that the students were less trained in scientific literacy competencies which included 1) explaining scientific phenomena, 2) evaluating and designing scientific investigations, and 3) interpreting data and scientific evidence. In addition, it is also necessary to develop interactive multimedia to support fun learning for students. Based on the results of a literature study and field survey, the research was continued with product development planning that included animation, images, video, text and sound.

Stages of Media Development and Theoretical Validity

At this stage media development was carried out according to the results of the preliminary study which was then reviewed by a chemistry lecturer. Ethnoscience-based interactive

multimedia that is developed contains local wisdom of the City of Surabaya such as the typical food of the City of Surabaya, namely '*lapis kukus'* and '*lontong kikil'*. The interactive multimedia is also adapted to the domains of scientific literacy, namely 1) context domain, 2) knowledge domain, 3) competency domain, and 4) attitude domain. Interactive multimedia is developed using the Smart App Creator software. The following are the results of product development that have been improved according to the results of the review.

Figure 4. Main page

Figure 5. Display Menu

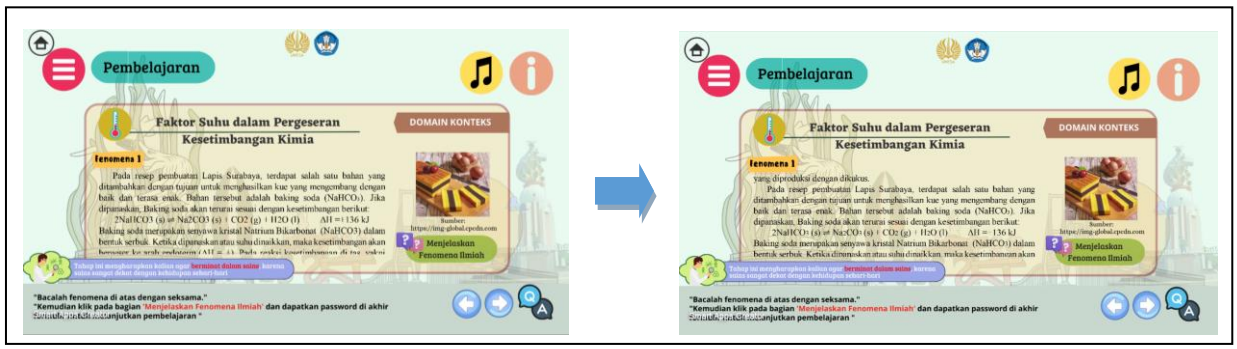

Figure 6. Improved Writing of Chemical Formula Index

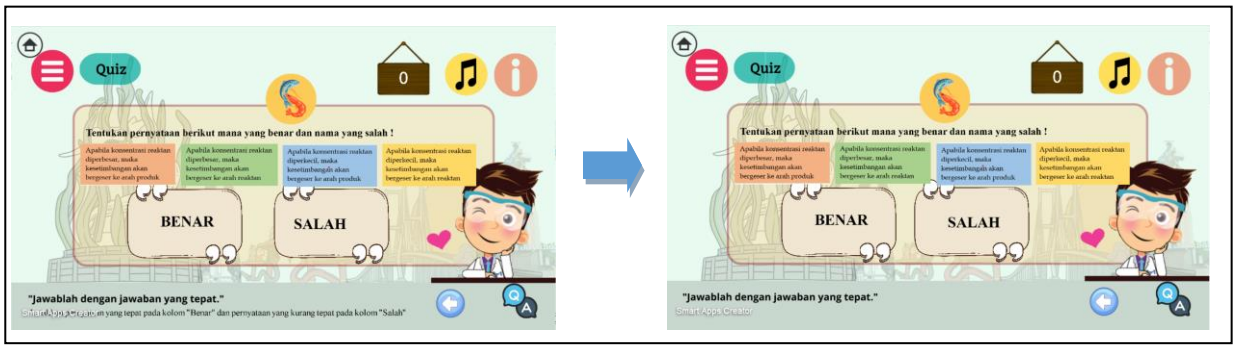

Figure 7. Improved Instructions on Quiz

After repairs were made, the developed interactive multimedia was validated by three validators. The validity of interactive multimedia is reviewed from the content and construct validity with the following results.

Table 5. Validity Result

Goal	No.	Rated Aspect	Score
Content Validity			
Knowing the suitability of the material with the curriculum	1	The material presented is in accordance with the learning objectives	4
Knowing the suitability of material with multiple	2	The material presented contains three multi-chemical representations (macroscopic, sub-microscopic, and	4

Goal	No.	Rated Aspect	Score
chemical representations to increase students' understanding		symbolic) in interactive multimedia	
Knowing the suitability of the material with scientific literacy competencies	3	The material presented trains students' scientific literacy skills in explaining natural phenomena	3
	4	The material presented trains students' scientific literacy skills in evaluating and designing investigations	3
	5	The material presented trains students' scientific literacy skills in interpreting data and scientific evidence	3
Construct Validity			
Knowing the developed multimedia engineering	1.	Interactive multimedia according to the learning styles of students (Audio, Visual, and Kinesthetic)	3
	2.	Instructions for using interactive multimedia are easy to understand.	3
	3.	Interactive multimedia is reusable (easy to use).	3
	4.	Interactive multimedia is interesting to use in learning.	3
	5.	Buttons and menu options work fine.	3
Knowing the presentation of the scientific literacy domain in the developed interactive multimedia	6.	There is a context domain that is presented in the form of a phenomenon	3
	7.	There is a knowledge domain (content, procedure and epistemic)	3
	8.	There is a competency domain (explaining scientific phenomena, evaluating and designing investigations, and interpreting scientific data and evidence)	3
Knowing the peculiarities of interactive multimedia developed based on ethnoscience	9.	Interactive multimedia developed using an ethnoscience approach in the form of local wisdom in the city of Surabaya and its surroundings	3
Knowing the suitability of the language used with PUEBI (*Panduan Umum Ejaan Bahasa Indonesia*)	10.	The language used in interactive multimedia is communicative (easy to understand language)	3
	11.	Proper use of language, sentences, and punctuation	3
Knowing the suitability of audio-visual communication in the developed interactive multimedia	12.	Interactive Multimedia display color combinations are well arranged and attractive	3
	13..	The accuracy of selecting colors, sizes and fonts in interactive multimedia	3
	14.	Appropriateness of images, videos and animations that support the material	3

Based on the results of the validity above, it was found that the developed interactive multimedia met the requirements to be declared valid with the acquisition of a mode score in each aspect, namely ≥ 3. On construct validity, a score of 3 is obtained by 50%, a score of 4 is 50%. While the content validity obtained 100% score 3 on each aspect. this shows that interactive multimedia can be categorized as valid and very valid based on the modified Likert scale.

Product Trial Stage

Media trials were carried out in class XI-MIPA 5 at SMAN 8 Surabaya on May 15, 16 and 22, 2023. The interactive multimedia that had been developed was distributed to students via the Google Drive link to be downloaded and installed on their respective devices. Students

carry out learning with interactive multimedia that has been developed using laptops and Android smartphones. After conducting the trial, students were given a response questionnaire to calculate the percentage of scores obtained and then calculate the average percentage of students' scores. The following is the calculation of the average percentage of student scores.

Based on the practicality score interpretation criteria, the developed interactive multimedia is stated to be practical with a practicality percentage of 94,4%.

N-gain Test

Furthermore, an analysis of students' pretest and posttest data was carried out to find out the effectiveness of the interactive multimedia that had been developed in increasing students' scientific literacy skills in chemical equilibrium material. The following is the result of n-gain analysis using SPSS 25.

Table 6. N-Gain Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain	35	.67	1.00	.8088	.10381
Valid N (listwise)	35				

Based on the results of the n-gain test above, a gain index of 0,8088 > 0,7 is obtained which can be categorized as high, so that it can be seen that there is an increase in the pretest and posttest scores of students which contain scientific literacy questions on chemical equilibrium.

Classical Mastery

Effectiveness data is also supported by classical mastery analysis obtained from students' posttest results. The following is the classical completeness data.

Table 7. Result of Classical Mastery

The number of students who complete	32
The number of students who did not complete	3
Number of students	35
Percentage of Classical Mastery	91,43%

Based on the results of classical completeness, it was obtained that 91,43% fulfilled the classical completeness criteria, namely ≥ 75%. Based on the n-gain test and the results of classical mastery, in this way the developed ethnoscience-based interactive multimedia can be declared effective in increasing students' scientific literacy skills in chemical equilibrium material.

In this study, there are previous studies that are used to support the latest research (Sari, 2023). Based on previous research conducted by Ratna Azizah Mashami and Khaeruman (2020) namely the development of interactive multimedia chemistry is said to be feasible to improve students' generic science skills with an average validity score of 92% and an average n-gain score of 58% in the medium category. in research conducted by Wafiqah Alvia Ramadhani, Syamsurizal, and Afrida (2022) showed that the use of interactive multimedia in learning was able to improve students' critical thinking skills with an n-gain score of 0.7 in the moderate category. In addition, there is also research conducted by Rahmi & Rosdiana (2018) with the results of his research which analyzed the use of ethnoscience-based Science Story media on student learning outcomes it was said that the use of the media could increase student learning outcomes by 0.6 with the n-gain test. With the existence of previous research

regarding the feasibility of an interactive multimedia in supporting chemistry learning and the existence of research on the use of an ethnoscience approach to improve students' literacy skills, this research is relevant and obtains the appropriate results, namely that interactive multimedia based on ethnoscience is feasible to use to improve students' scientific literacy skills on chemical equilibrium material by meeting the criteria of validity, practicality, and effectiveness.

CONCLUSION

Based on the discussion above, the conclusions obtained are that interactive multimedia based on ethnoscience can be declared feasible to be used to improve students' scientific literacy skills in chemical equilibrium material with a validity score of ≥ 3 in each aspect, a practicality score of 94,4%, and an effective score of ≥ 0,3 obtained from the n-gain test of 0,8088 with the high category and classical completeness of 91,43%. This research has limitations, namely it is carried out only until limited trials, so that for the product improvement stage after limited trials until the final product is produced, further research can be carried out. In implementing interactive multimedia during the limited trial it was found that the devices that can be used are PCs and Androids. Devices that cannot be used are iOS-based, such as iPhones, iPads, and Macbooks. so it is necessary to pay attention to the specifications of the devices used in implementing the interactive multimedia that have been developed.

RECOMMENDATIONS

In conducting media trials, there were obstacles faced by researchers and students, namely the developed interactive multimedia could not be accessed by iOS users and on some Android smartphones that had lower specifications had difficulty using interactive multimedia. This can be used as an improvement for future research in the development of interactive multimedia. It is hoped that future research can develop interactive multimedia that can be accessed on all types of devices.

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