

# Artikel Aisyah Verolita

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# Development of Interactive Learning Media Digital Based “E-MIREDOKS” on Redox Reaction Material

Aisyah Verolita Firdauz, Sukarmin

Chemistry Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya,  
Jl. Ketintang Campus, Surabaya 60231, Indonesia

21

## Abstract

*This research aims to develop and determine the achievability of E-MIREDOKS (Redox Reaction Interactive E-Module) as an interactive and digital-based chemistry learning media in improving the motivation and learning outcomes of students on redox (reduction-oxidation) reaction material. The research method using Research and Development by Sukmadinata comprises the stages of preparatory study, media development, and media testing, which are only carried out up to the limited test stage, which uses 36 students (XI IPA 3, SMAN 20 Surabaya). The media were tested using validity sheets, pretest and posttest sheets, student responses, and observation sheets. The media is said to be achievable based on its validity, effectiveness, and practicality. The validity's result, content, and construct validity in succession were 85,56% and 85.93%, respectively, in the exceptionally valid category. The media's effectiveness is obtained from the pretest and posttest results with a sig.(2-tailed) value of  $0.00 < 0.05$  ( $\alpha$ ), i.e., there's a contrast in the average score between the results of the pretest and posttest. A total of 31 of the 36 students passed individual learning accuracy, and 86.11% passed classical learning accuracy. The media's practicality is obtained from the student response sheets, which resulted in a percentage of 92.63%, and the observation result of the student being 96.67%, which both had a place in the exceptionally practical category.*

**Keywords:** Interactive Learning Media, E-Module, Digital, Redox Reaction.

## INTRODUCTION

The natural science consists of several branches of science, one of which is chemistry. Chemistry is the heart of science that connects science, technology, engineering, and mathematics and plays an important role in various fields of science such as biology, geology, environmental science and others (Flowers et al., 2015). Chemistry studies the structure, arrangement, and changes of matter, as well as the phenomena that accompany the change of matter (Nissa et al., 2019).

Chemistry consists of three representative aspects: microscopic, macroscopic, and symbolic (Qibtiyah & Sukarmin, 2022). Flowers et al (2015) explained that microscopic aspects are micro-sized subjects, i.e., molecules, atoms, ions, electrons, protons, neutrons, and chemical bonds that are not directly visible to the eye. Macroscopic aspects can be perceived through the senses of vision and touch; in this case, physical and chemical properties are often found in everyday life. Symbolics are used to represent the components of the microscopic and macroscopic aspects, such as elements, formulas, and chemical equations. It makes chemistry as subject that is not easy to teach because it has a lot of abstract concepts that are foreign or rarely heard in students' ears (Treagust & Chittleborough, 2001). Besides, chemistry is a complex concept, evolving from simple concepts to higher-level concepts (Sastrawijaya, 1988). Understanding the basic concept is crucial, as it will be used as a foundation for advanced material (Treagust & Chittleborough, 2001). According to Nakhleh (1994), as quoted in Treagust & Chittleborough (2001), the difficulties encountered by the students in studying chemistry are due to their lack of understanding of basic concepts properly. One of the basic concepts that is difficult to understand but very important to understand is the concept of reduction-oxidation reactions (redox reactions).

Initially, a redox reaction was described as a chemical reaction involving oxygen, which then evolved into a reaction that involves electron transfer and ended up using the concept of changing the number of oxidations to define a redox reaction (Flowers et al., 2015). Redox reactions involve reducing agents and oxidizing agents. A reducing agent is a substance that undergoes an oxidation reaction by releasing electrons, gaining oxygen, or undergoing an increase in the number of

oxidations. An oxidizing agent is a substance that undergoes a reduction reaction by gaining electrons, releasing oxygen, or undergoing a decrease in the number of oxidations. The things that occur in that reaction are part of the microscopic aspect (Suryati et al., 2022). The microscopic aspect and the use of chemical symbols become quite difficult to understand, unlike the phenomena on the macroscopic aspect that are quite easy to understand (Sudria et al., 2011). Based on the pre-research survey, 81.25% of the students had difficulty with the redox reaction material. Such difficulties can result in a sense of being tired, bored, and lacking interest in studying material, which can eventually result in decreased learning motivation and learning outcomes. One of the endeavors that can be made is to provide an attractive learning media.

Learning media is an element of the delivery strategy that will be loaded and then delivered to students (Tafonao, 2018). Learning media has a significant effect on learning by having a positive influence on student learning outcomes (Nida et al., 2020). Learning media is also effective in increasing the learning motivation of students (Tafonao, 2018). One of the learning media that can be utilized is the e-module, which is a module displayed in an electronic format that runs on a computer (Laili et al., 2019).

E-modules are designed to be easily accessible, taken anywhere, and used for a long time (Istiqoma et al., 2023). The e-module can be built with the help of a professional flip builder, which is software to make an e-book in the form of a more interesting flipbook by providing features such as video, audio, animation, images, etc (Sirait, 2021). There is also a quiz maker feature that can be used as a question practice that can be played repeatedly. These features make the e-module provide an audio, visual, and interactive learning experience. Interactive e-modules make students more active in the learning process in class (Prabu et al., 2023). Research conducted by Herawati and Muhtadi (2018) says that interactive e-modules provide positive and useful results in learning, which is demonstrated by significant contrasts within the pretest and posttest scores of the students.

The utilization of interactive e-modules in chemistry learning is one of the endeavors to apply technological advances. The rapidly evolving application of technology enables learning to take place interactively, either between teachers and students or with learning media (Awwalina & Indana, 2022). This digital-based learning medium has begun to flourish in the middle of the 4.0 industrial revolution. The 4.0 revolution began with the emergence of the digital revolution and began to apply it to all kinds of technologies (Annisa, A., 2021). The advancement of information and communication technology in the education's field is the result of the Industrial Revolution 4.0, which is anticipated to be utilized as facilities and infrastructure to facilitate the learning process (Putriani et al., 2021).

Based on the available data, this research aims to develop an interactive digital learning media, E-MIREDOKS (Redox Reaction Interactive E-Module), as a learning media for redox reaction material. E-MIREDOKS will be tested the achievability based on their validity, effectiveness, and practicality in improving student motivation and learning outcomes. With the presence of E-MIREDOKS, this is expected to facilitate and assist students in learning redox reaction material.

## METHOD

This research uses the Research and Development Method by Sukmadinata by modifying the step-by-step research and development of Borg and Gall (Sukmadinata, 2016). This method can be used to develop a learning product. The method comprises the stages of preparatory study (literature study and field study), media development, and media testing (expert validity, limited test, and extensive test). This research is being conducted until the limited test stage. In the preparatory study, material studies, class observations, and interviews were conducted. The data is gathered, organized, and developed so that E-MIREDOKS (Redox Reaction Interactive E-Module) is formed. The media will then determine its achievability as a learning media by testing its validity (content and construction), its effectiveness, and its practicality.

### Validity Test

The data resulting from the media validity test obtained is accumulated using calculations (Formula 1). The scores are then interpreted using a percentage of the Likert Scale validity (Table 1).

**Formula 1.** Calculation of The Likert Scale

$$P(\%) = \frac{\sum \text{Score obtained}}{\text{Criterion score}} \times 100\% \quad (\text{Suyono, 2015})$$

Description :

- Criterion score = highest score of each item x  $\Sigma$  items x  $\Sigma$  validator

**Table 1.** Interpretation of Likert Scale Validity (Riduwan, 2015)

Percentage (%)	Assessment Category
0 – 20	Exceptionally Invalid
21 – 40	Invalid
41 – 60	Enough
61 – 80	Valid
81 – 100	Exceptionally Valid

E-MIREDOKS is said to be valid when the percentage is  $\geq 61\%$  or belongs to the valid or exceptionally valid category, and each aspect must obtain a score  $\geq 3$ .

**Effectiveness Test**

E-MIREDOKS was tested on 36 students in grade XI IPA 3, SMAN 20 Surabaya, who have obtained redox reaction material. Using the one-group pretest-posttest design system, the student will be given a pretest in advance, continue learning using E-MIREDOKS, and then be given posttest. The results of the pretest and posttest will be tested for normality using SPSS software. Normality tests are performed to see if the data obtained is distributed normally or not. The normality hypothesis is as follows:

If  $H_0$ : Data comes from a population with a normal distribution

If  $H_1$ : Data comes from a population with an abnormal distribution

Then the normality hypothesis is tested using the P-value, as follows:

If the P-value  $> \alpha$ , then  $H_0$  is accepted      If the P value  $< \alpha$ , then  $H_0$  is rejected

Then, test the data using a Paired Sample t-test that is performed to find out the contrasts in the pretest and posttest scores of the students, with the following hypotheses:

If  $H_0$ : There is no average contrast in pretest and posttest scores

If  $H_1$ : There is an average contrast in pretest and posttest scores

Then test the hypothesis t-test (Paired Sample t-test) using the P-value as follows:

If the P-value  $> \alpha$ , then  $H_0$  is received      If the P-value  $< \alpha$ , then  $H_0$  is rejected

Significant contrasts between pretest-posttest results, suggest E-MIREDOKS is effective as a learning media. To find out the criteria for individual accuracy and the percentage of classical accuracy, use the calculations (Formulas 2 and 3).

**Formula 2.** Individual Accuracy

$$\text{Individual Accuracy} = \frac{\sum \text{Amount of the correct answer}}{\text{Amount of all questions}} \times 100 \quad (\text{Erni, 2016})$$

**Formula 3.** Classical Accuracy

$$\text{Classical Accuracy} = \frac{\sum \text{Amount of students who got scores} \geq 75}{\text{Amount of all students}} \times 100\% \quad (\text{Depdiknas, 2004})$$

Students are said to have passed individual accuracy when they get a score of  $\geq 75$ . As for classical accuracy, in a classroom,  $\geq 85\%$  of students pass the score that was already specified.

**Practicality Test**

The students will fill in a student response sheets, in which each aspect contains a scoring column. In addition, there was a student observation sheet with the scores given by the observers. The Guttman scale criteria (Table 2) are used to determine the score, and then the scores are calculated using calculations (Formula 4).

**Table 2.** The Guttman Scale Criteria (Riduwan, 2015)

Answer	Score	
	Positive statement	Negative statement
Yes	1	0
No	0	1

**Formula 4.** Guttman Scale Calculation

$$P(\%) = \frac{\sum \text{Student answer score}}{\text{Amount of all students}} \times 100\% \quad (\text{Suyono, 2015})$$

**Table 3.** Likert Scale Practical Interpretation (Riduwan,2015)

Percentage (%)	Assessment Category
0 – 20	Exceptionally Less Practical
21 – 40	Less Practical
41 – 60	Enough
61 – 80	Practical
81 – 100	Exceptionally Practical

The result of the calculation is interpreted using a Likert scale for practical interpretation (Table 3). E-MIREDOKS is considered practical when the percentage is  $\geq 61\%$ , or in the category of practical or exceptionally practical.

**RESULTS AND DISCUSSION**

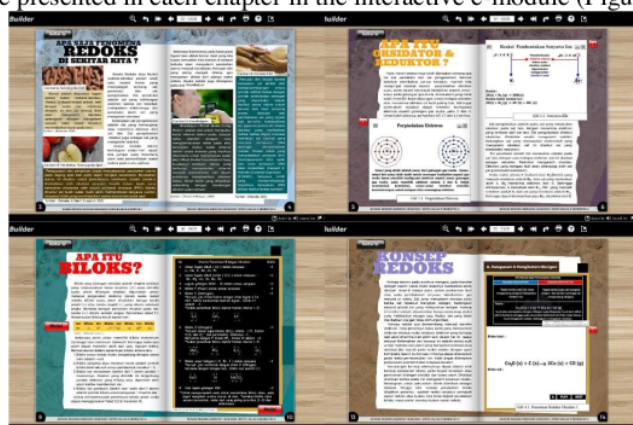
This research is about research development of E-MIREDOKS as a digital-based interactive learning media on redox reaction material, which comprises of three main stages: a preparatory study, media development, and media testing that is conducted only up to a limited test stage.

**Preparatory Study**

The literature study is carried out by studying redox reaction material and collecting data from various literary sources. The field study was conducted by spreading pre-research surveys to the students. A total of 81.25% of students had difficulties with redox reaction material. The use of monotonous learning media also makes students feel bored. Based on interviews with chemistry teachers, the learning media used at SMAN 20 Surabaya are package books, LKS, PPT, video, animations, and whiteboards. A total of 93.75% of students didn't hesitate to ask their teachers if they were experiencing learning difficulties, but 93.76% said they preferred learning on their own when it was provided with an interesting, interactive, and comprehensive learning media. One type of learning media is interactive e-modules. Not only text, but it also presents images, videos, gift animations, voice recordings, and navigations that make students more interactive with the media (Murod et al., 2021). There are also quizzes and competence tests that can be used for training and evaluation of students' learning outcomes.

**Media Development**

Media development starts with design selection and display, and then prepare the material and the contents that will be presented in each chapter in the interactive e-module (Figure 1).

**Figure 1.** E-MIREDOKS, the material in each chapter

The process of design and display, the preparation of the materials using Canva, and the final product as a pdf. The pdf is then converted using Flip Builder Professional, forming the interactive e-module. With Flip Builder Professional, the e-module added video, animation, gifts, navigation, quizzes, and competence tests connected with Google Forms.



Figure 2. E-MIREDOKS Content

E-MIREDOKS was then examined by a chemistry lecturer. It gets input by adding shortcuts to each page, adding play, stop, and next buttons to the animations and gifts, and changing the format of the quiz using the facilities available on the Flip Builder Corporation. Those suggestions are used to fix E-MIREDOKS. E-MIREDOKS (Figure 2) is composed of lists of contents, images, tables, and animations of gifts, instructions for use, basic competencies and indicators of competence achievement, supporting videos of material, redox reaction material accompanied by images and gift animations, quizzes as exercises, and competence tests.

#### Media Test

Media testing includes a validity test and a limited test. In limited tests, the media will be tested for its effectiveness and practicality.

#### Validity Test

There are three validators who test the validity of E-MIREDOKS, two chemistry lecturers from Unesa and a chemical teacher from SMAN 20 Surabaya. On the validity sheet, there are assessment aspects that assess the media in terms of content and construct, and the results are as follows (Table 4).

Table 4. E-MIREDOKS Validity Results

Assessment Aspect	Percentage (%)	Category
<b>The Content Validity</b>		
Compatibility of material and concept	86,67%	Exceptionally Valid
Compatibility of questions with material	83,33%	Exceptionally Valid
Compability in improving student learning outcomes and motivation	86,67%	Exceptionally Valid
<b>Average</b>	<b>85,56%</b>	<b>Exceptionally Valid</b>
<b>The Construct Validity</b>		
Presentation of material, content, features, and instructions for use	88,89%	Exceptionally Valid
Language usage	84,44%	Exceptionally Valid
Graphical quality	84,44%	Exceptionally Valid
<b>Average</b>	<b>85,93%</b>	<b>Exceptionally Valid</b>

The validity result in terms of content shows the compatibility of the material, concept, and questions in E-MIREDOKS and the media's compability in improving the learning outcomes and learning motivation of the students with an average overall percentage of aspects of 85.56% and belongs to the exceptionally valid category. As supported by Karim's research (2018), interactive e-modules accompanied by images, videos, and animations proved to be able to support the students in

understanding the subject. Meanwhile, the construct validity result shows that the presentation of material, content, features, and instructions on the use of the media, language use, as well as graphic quality, gained an average overall percentage of 85.93%, which belongs to an exceptionally valid category. The material on E-MIREDOKS is presented in a comprehensive and structured manner, from general to specific, with themes such as an encyclopedia. Interesting media appearances can attract the student's interest in reading material (Mumpuni, 2019). The use of clear language, which has been adapted to the language used on a daily basis, provides an interactive effect that is as if the student interacts with the teacher (Wulandari et al., 2021).

The description above is in line with research from Asri (2022) that states that interactive e-modules are indeed worthy of use as a learning media, and their result is based on the validity result (content and construct). During the validity stage of this media, the researchers obtained advice from validators aimed at improving the video layout and animation. The results of the repairs were subsequently tested on a limited test stage.

#### Limited Test

Limited tests were tested on 36 students in XI grade, IPA 3, SMAN 20, and Surabaya. This stage is done to find out the effectiveness and practicality of E-MIREDOKS.

#### Effectiveness test

The effectiveness of E-MIREDOKS is obtained from the data of the pretest and posttest students, consisting of 15 multiple-choice questions, each of which represents an indicator of competence achievement. E-MIREDOKS is said to be effective as learning media if the student is able to understand the material well so that it affects its formative evaluation (Plomp & Nieveen, 2010). Formative evaluation is used to determine how much achievement has been achieved through the planned learning process (Zahir et al., 2021). The data obtained was subjected to a normality test (Table 5) and a paired sample t-test (Table 6).

**Table 5.** Normality Test Results

	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	Df	Sig.
Pretest	.144	36	.058
Posttest	.145	36	.055

29

**Table 6.** Paired sample t-test test results

Pair 1	Pretest – Posttest	T	Df	Sig. (2-tailed)
		-28.134	35	.000

In the results of the normality test (Table 5), the P-value is "Sig.," which indicates the value of significance, obtained as 0.058 in the pretest and 0.055 in the posttest. Both values are  $>0.05$  ( $\alpha$ ), which means  $H_0$  was received and the data obtained is distributed normally. In the paired sample t-test result (Table 6), the sig. (2-tailed) value is 0.00. The value is  $<0.05$  ( $\alpha$ ), meaning  $H_0$  was rejected and  $H_1$  was received. That means there's a contrast between the average score based on the results of the pretest and the posttest. Furthermore, the results of pretest and posttest will be processed to determine the individual accuracy of the students and the classical accuracy, with the results as follows (Table 7).

**Table 7.** Students' learning outcomes

Aspect	Pretest	Posttest
Amount of The Students	36	36
Lowest Score	0,00	66,67
Highest Score	53,33	100,00
<b>Average Score</b>	<b>22,01</b>	<b>86,11</b>

Based on Table 7, showing the improvement in student learning outcomes seen from the pretest average, 22.01 increased to 86.11 on the posttest average. A total of 31 of the 36 students who passed the specified score were included in the individual accuracy after using E-MIREDOKS. The

percentage of classical accuracy increased from 0.00% to 86.11%. Thus, class XI IPA 3 was declared classically accurate because  $\geq 85\%$  of students accurately the study. Such individual and classical accuracy proves that E-MIREDOKS has a positive influence on students learning outcomes. This is supported by Istiqoma's research (2023), that e-modules can improve students learning outcomes, as proved by the contrast in learning outcomes between the pretest and posttest results with sig values  $< 0.05$ . The systematic, interactive presentation and the use of easy-to-understand language help the student understand the material, thus giving positive results for the student, especially in terms of their learning outcome (Herawati & Muhtadi, 2018). Quizzes and exercises presented on E-MIREDOKS can be played repeatedly. When the student repeats the activity continuously, the learning process will be stored in long-term memory (Suryana et al., 2022). So when a student faces a problem in the form of a similar question, they can answer it easily because they are accustomed to it.

#### Practicality Test

The student response sheets result are used to find out the students' responses and opinions about E-MIREDOKS from the point of view of its practicality as a learning media, with the results as follows (Table 8).

**Table 8.** Results of the student response sheets

No	Practicality Aspects	Percentage (%) and Category
1.	Students' interest in the use of media	95,83% (Exceptionally Practical)
2.	Ease of use of media	89,81% (Exceptionally Practical)
3.	Students' activity in the use of media	95,83% (Exceptionally Practical)
4.	Language usage	90,00% (Exceptionally Practical)
5.	Media benefits	91,67% (Exceptionally Practical)
Average		92,63% (Exceptionally Practical)

Based on the data above (Table 8), the practical aspect obtained an average overall percentage of 92.63%, which belongs to exceptionally practical category. This result is in line with Purwati's research (2015), that the materials packaged in e-modules presented in the form of text, images, video, or audio can support the learning process, with an average percentage of 87% of students responding positively. E-modules that are interactive make students more active in learning, so they support self-directed learning (Prabu et al., 2023). That shows that students are interested in learning using E-MIREDOKS, as proven by the student observation sheet that contains the entire learning process (Table 9).

**Table 9.** The Results of Students' Observation Sheets

No	Student Activity	Percentage (%) and Category
1	Installing and accessing E-MIREDOKS	66.67% (Practical)
2	Using features, videos, gift animations, and navigation	100,00% (Exceptionally Practical)
3	The quiz and competence test operated well	100,00% (Exceptionally Practical)
4	Ease of use and no error found	100,00% (Exceptionally Practical)
5	Students can answer questions from researchers well during learning using the media	100,00% (Exceptionally Practical)
6	Interactive students during learning	100,00% (Exceptionally Practical)
7	Enthusiastic students during learning	100,00% (Exceptionally Practical)
Average		96,67% (Exceptionally Practical)

Table 9. shows the observation results of the students, who obtained an average overall percentage of 96.67%. These results are supported by studies that show an increase in the activity of students in learning from 66.80% to 80.86% after applying the e-module (Purwati, 2015). Thus, the E-MIREDOKS media is categorized as exceptionally practical and worthy as a learning media to use in the chemistry learning process.

## CONCLUSION

The conclusion of E-MIREDOKS's research is that it is achievable to use it as an interactive learning media for redox reaction material. Proved by the results of content validity and construct validity with successive percentages of 85.26% and 85.93%, both included exceptionally valid categories. The effectiveness is obtained by a sig. (2-tailed) value of  $0.00 < 0.05$  ( $\alpha$ ) on the paired sample t-test, which means there is a contrast in the pretest and posttest average score. 31 out of 36 students passed individual learning accuracy, and 86.11% passed classical learning accuracy. The practicality is obtained from a positive response from the students; the percentage is 92.63% and 96.67% from the observations, both included exceptionally practical categories.

## RECOMMENDATION

E-MIREDOKS as interactive learning media can be used for offline or online (distance) learning, as well as for supporting self-learning.

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