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Validity of Interactive Learning Media Based on Moodle's Learning Management System with Three Chemical Representative Levels (Macroscopic, Submicroscopic, and Symbolic) in Electrolysis Cell Sub Material

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Abstract: Validity of Interactive Learning Media Based on Moodle's Learning Management System with Three Chemical Representative Levels (Macroscopic, Submicroscopic, and Symbolic) in Electrolysis Cell Sub Material. This study aims to determine the validity of Interactive Learning Media Based on the Moodle Learning Management System with Three Chemical Representative Levels (Macroscopic, Submicroscopic, and Symbolic) in the Electrolysis Cell Sub Material seen from the content and construct validity. This study uses a Research and Development (R&D) type of research which only reached the design revision step from the validation results. This study used an interactive media review sheet instrument and an interactive media validation sheet. Based on the validation results, it shows that the developed interactive media obtained a percentage of 92,5% for content validity which was included in the very valid category, and 88% for construct validity which was in the very valid category to use as a media to prevent misconceptions in students with three levels of chemical representation.

Keywords: Interactive media, Moodle, three levels of Chemical Representation, Electrolysis Cell.

Abstrak: Validitas Media Pembelajaran Interaktif Berbasis Learning Management System Moodle dengan Tiga Level Representatif Kimia (Makroskopis, Submikroksopis, Dan Simbolik) Pada Sub Materi Sel Elektrolisis. Penelitian ini bertujuan untuk mengetahui validitas Media Pembelajaran Interaktif *Berbasis Learning Management System Moodle dengan Tiga Level Representatif Kimia (Makroskopis, Submikroksopis, Dan Simbolik) Pada Sub Materi Sel Elektrolisis dilihat dari validitas isi dan konstruk. Penelitian ini menggunakan jenis penelitian Research and Development (R&D) yang hanya sampai pada tahapan revisi desain dari hasil validasi. Penelitian ini menggunakan instrumen lembar telaah media interaktif dan lembar validasi media interaktif. Berdasarkan hasil validasi menunjukkan bahwa media interaktif yang dikembangkan memperoleh presentase 92,5% untuk validitas isi yang mana termasuk kategori sangat valid, dab sebesar 88% untuk validitas konstruk yang mana termasuk kategori sangat valid digunakan sebagai media untuk mencegah miskonsepsi pada peserta didik dengan tiga level representatif kimia.*

Kata Kunci: *media interaktif, moodle, tiga level representative kimia, sel elektrolisis.*

• INTRODUCTION

Chemistry is a science that deals with discussing the composition and properties of a material (Petrucci et al., 2011). In chemistry, knowledge is divided into three different levels: macroscopic, symbolic, and microscopic (Talanquer, 2011).

Macroscopic representation is obtained from observations in daily life and can be measured. Examples are mass, pH, temperature, and osmotic pressure. Submicroscopic representation includes visual models to explain various phenomena at the macroscopic level. The model described could vary widely, be it two-dimensional or three-dimensional. At the same time, symbolic representation includes reaction equations, stoichiometry, mathematical calculations, and chemical formulas (Gilbert and Treagust, 2009).

Nowadays, some students have difficulty learning the basic concepts of chemistry, most of which are submicroscopic or invisible to the eye (abstract) (Sirhan, 2007). Mastery of submicroscopic concepts has a higher level of difficulty than macroscopic ones that macroscopic can observe (visible) because it requires more reasoning and higher logic to solve problems that cannot be observed directly (Sirhan, 2007).

Electrochemistry is one topic that includes some abstract concepts. Such as chemical reaction processes that cannot be observed or the scope of the submicroscopic level (Sirhan, 2007). Electrochemistry is a lesson that studies the process of electrical changes that produce oxidation-reduction reactions and others (Brady et al., 2012). Electrochemistry discusses two sub-subjects, namely voltaic cells and electrolysis. It can happen when electrical energy is passed through an electronic or ionic solution. In electrolysis, the electrical energy produces a non-spontaneous oxidation-reduction reaction (Brady et al., 2012).

The existence of a submicroscopic level in electrochemistry, especially in electrolysis cells, makes it difficult for some students to understand this material (Sirhan, 2007). In addition, students also have difficulties determining the electrolysis cell's product and calculating the electrolysis cell. The result is that most students do not understand the concept of an electrolytic cell (Sia et al., 2012). Even though it is crucial to balance the conceptual relationships of the three levels so that students can understand the material in-depth so that no misunderstandings or misconceptions about the material (Tuysuz et al., 2011). It must be essential to develop a teaching media that correlates the three representative chemistry levels for the electrolysis sub-material to improve students' understanding.

One type of media that can use a multi-representation approach and effectively increase learning acquisition is an interactive multimedia (Astuti et al., 2016). In addition, the use of interactive multimedia when conveying the concept of electrolysis is recommended by the Malaysian curriculum division (Sia et al., 2012). Multimedia itself integrates digital media, including a combination of electronic text, moving image graphics, and sound in a computerized system (Elaine and Andy, 2012). In the design and manufacture of interactive multimedia, several multimedia principles must be considered, especially in terms of interactivity, namely the existence of dialogue or conversation between users. The communication/dialogue between fellow users or between users and admins can help increase interactivity and sharpen understanding of interactive multimedia content (Sandra and Mike, 2001).

One media that can fulfill the principle of interactive multimedia is Learning Management System (LMS). LMS has communication features between users in chat, discussion, and comments (Turnbull, 2019). Learning Management System (LMS) can

be defined as a web-based software platform that can provide interactive online learning and automatically manage educational content (Turnbull, 2019). In addition to having communication and chat features, the facilities of the LMS include relatively easy course management, a complete assessment system, being able to know learning progress, file and data storage, guaranteed class security, and access via smartphones (Turnbull, 2019). There are two types of LMS, namely LMS for commercial purposes such as blackboard, Saba Software, and other, and open-source LMS such as Moodle, a tutor, Sakai, Lilias, Cralorine, and many more (Cavus and Taeyang, 2014).

Moodle is a modular object-oriented dynamic learning environment that can be interpreted as a place to learn using a dynamic web-based object-oriented model (Munir, 2012). Some of the advantages of Moodle are: Its use is appropriate for online classes, learning outcomes are relatively the same as face-to-face, the right to modify learning materials for teachers, easy to install, only requires one database, lessons are equipped with explanation displays, security guarantees, and various language versions are available. (Munir, 2012). In addition, when compared to several other open-source LMS, Moodle is the best LMS when viewed from the completeness of features and ease of operation (Cavus and Taeyang, 2014). So the selection of Moodle as a means to develop learning media is considered very suitable.

Based on described, it is deemed necessary to develop interactive learning media based on the Moodle Learning Management System with three levels of multi-representative chemistry (macroscopic, submicroscopic, and symbolic) in the electrolysis cell sub-material, which is expected to be worthy of being an alternative new learning media for the sub-material electrolytic cell.

- **METHOD**

This study uses a design that refers to the research and development (R&D) method written by Sugiyono (2011). The R&D method is used to produce specific products and test the validity, practicality, and effectiveness of the product. However, this research is only limited to revision design based on validator suggestions. The Research and Development (R&D) research method has ten stages, namely (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) trial product, (7) product revision, (8) use trial, (9) product revision, and (10) mass production (Sugiyono, 2011).

This research produces interactive learning media based on e-learning moodle with three levels of representative chemistry (macroscopic, microscopic, and symbolic) in the electrolysis cell material.

The steps in this research are:

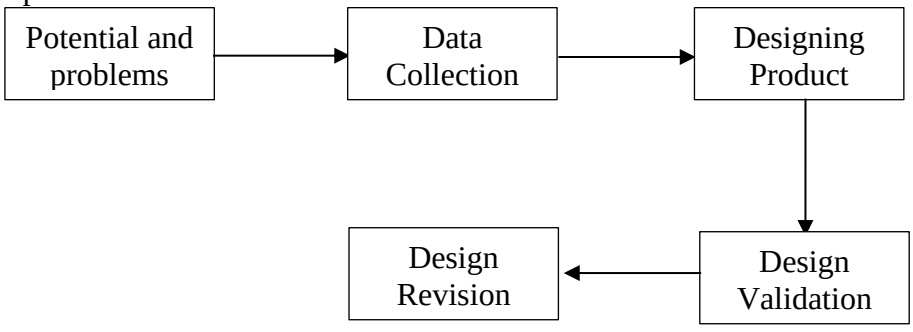


Figure 1. R&D Method but limited to design revision

This research after being reviewed by the reviewing lecturer followed by validation by two chemistry lecturers. Percentage the results of the validation sheet using calculations Likert scale (Riduwan, 2015) as shown in Table 1 below:

Table 1. Likert Scale

Values	Assesment
1	Very Bad
2	Bad
3	Fairly Good
4	Good
5	Very Good

The formula used to calculate the percentages are as follows:

$$P\% = \frac{\Sigma \text{ Data collection results score}}{\text{Criteria score}} \text{ x } 100\%$$

P = Validation Percentage

Criteria score = highest score x aspect x respondent

This validation analysis aims to get validity in using interactive media, including content and construct validity. Percentage of validation sheet data obtained based on Likert scale calculations, the results of the validity of the interactive media developed with interpretation criteria score (Riduwan, 2015) as shown in table 2 below:

Table 2. Interpretation Criteria Score

Percentage (%)	Criteria
0-20	Invalid
21-40	Less Valid
41-60	Quite Valid
61-80	Valid
81-100	Very Valid

Based on the validity criteria above, interactive media is valid if the percentage of assessment results is ≥ 61%.

• RESULT AND DISCUSSION

Potential and Problems

At this step, the aim is to identify the initial problems that occur in the field. The problem in the field is that many students do not understand the sub-concept of the electrolysis cell. The teacher in conveying the material does not use the suitable method, which does not convey the whole of three levels of representative chemistry. It must be addressed soon so that students can understand the whole material and there are no misconceptions. Based on field studies conducted, there is still a lack of interactive media developed with three levels of representative chemistry. So it is necessary to develop interactive media based on Moodle LMS with three representative levels, which are expected to create a complete understanding for students in the electrolysis cell sub material.

Data Collection

At this step, Data collection aims to collect various information and data related to research that can be used for product development planning which is expected to solve

students' learning problems. Data that need to be collected to develop this interactive media are Core Competencies and Basic Competencies of learning used in electrolysis cells sub-materials. The following are Core Competencies and Basic Competencies:

- Core Competencies 3:
  Understand, apply, analyze factual, conceptual, procedural knowledge based on their curiosity about science, technology, art, culture, and humanities with insight into humanity, nationality, state, and civilization related to the causes of phenomena and events, as well as apply procedural knowledge in the field of study-specific according to their talents and interests to solve problems.
- Basic Competencies (KD):
  3.4 Explain the processes that occur in electrolytic cells and their uses in daily life.

Designing Product

Product design development is done by creating a series of media by applying three representative levels (macroscopic, submicroscopic, symbolic), which design will place in the Moodle Learning Management System website mediakimia.rnhlearning.com systematically. The following displays a login page, dashboard, and courses on the interactive media-based Moodle LMS developed.

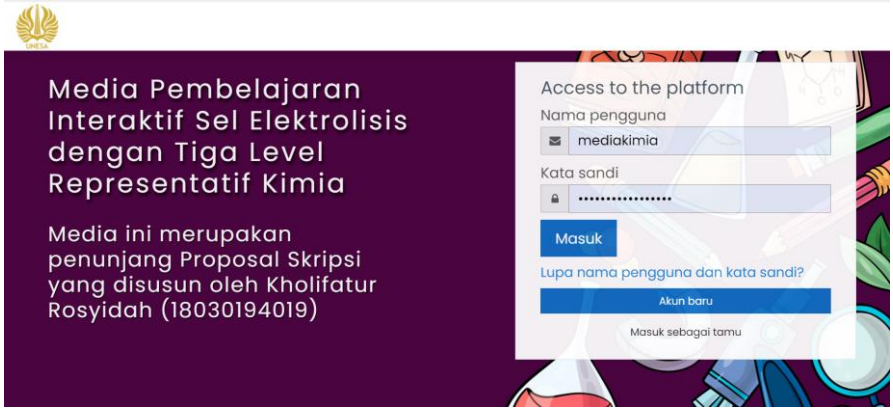


Figure 2. Login Page

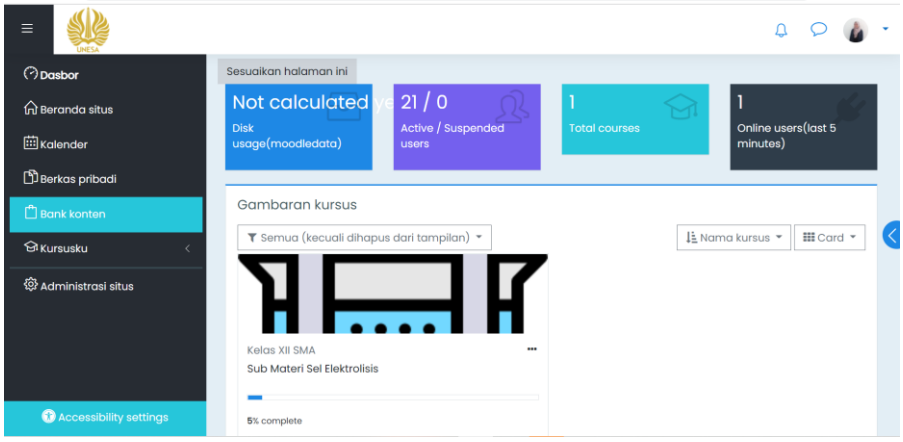
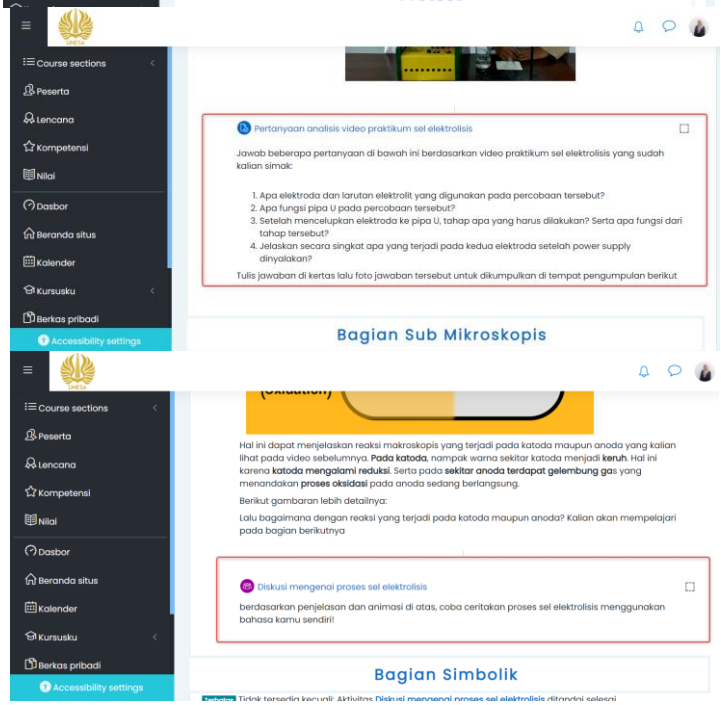


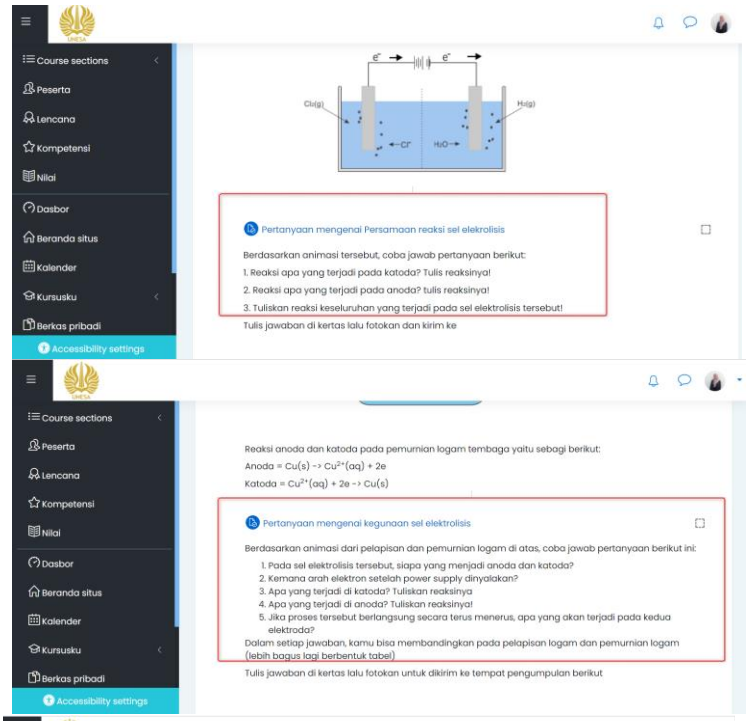
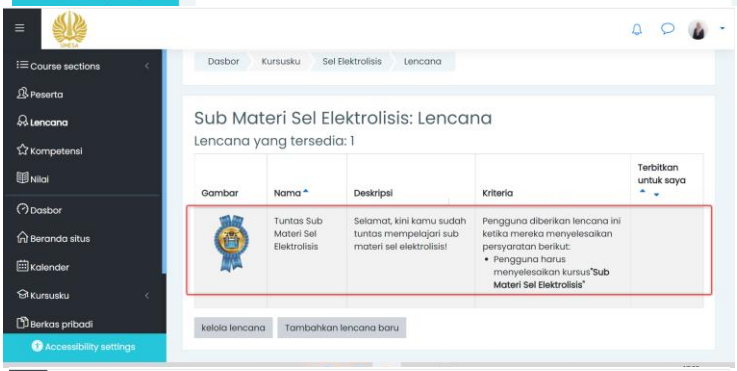
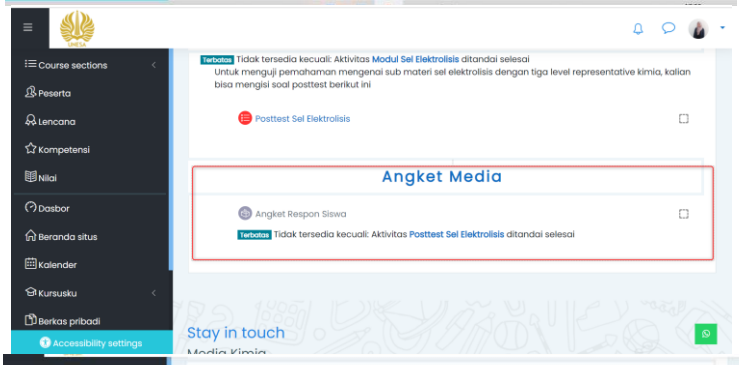
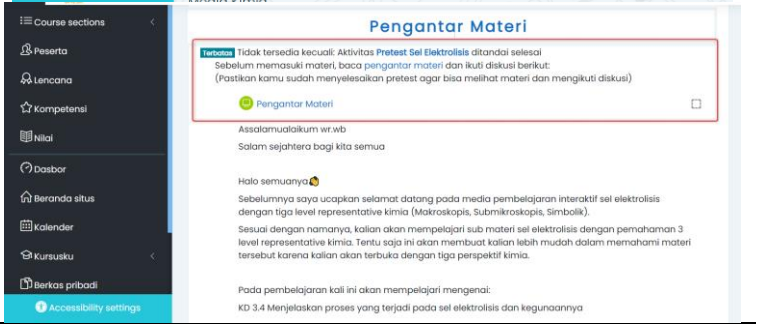
Figure 3. Dashboard Page

Figure 3. Courses Page

interactive media that has been designed, produced draft I, then reviewed by a chemist lecturer for suggestions and comments. After being reviewed, then revised, resulting in draft II to proceed to the device validation process. The results of the revision of the interactive media review can be seen in Table 3 below:

Table 3. Revision Result

No	Suggestion	Results
1.	Add student attendance section in the course page.	
2.	Add questions or discussions to every video or animation in the course so that the animation is more meaningful than before.	

No	Suggestion	Results
3.	Maximize the Moodle feature by adding badges and student response questionnaires.	  
4.	Setting the moodle so that students cannot open the following material before working on the material in that section.	

Design Validation

After being reviewed by the lecturer, the next step is media validation. This step consists of content and constructs validation. This validation is carried out to assess the feasibility and validity of the media. Validators are asked to assess the media on each aspect, namely content validity and construct validity. Validators also provide to give suggestions. The validation results can be seen in Table 4 below:

Table 4. Validation results

No	Validity	Percentage (%)	Category
1.	Content	92,5%	Very valid
2.	Construct	88%	Very valid

Table 4 above shows that interactive media developed get 92,5% on content validity and get 88% on construct validity. Both validities are included in the very valid category. It proves that interactive media is feasible to use. By details can be explained as follows:

Content Validation

Content validity is a feasibility test of interactive learning media based on aspects of the suitability of the material and aspects of conformity with the three levels of chemical representation in the media. The results of the validation can be seen in the table 5 below:

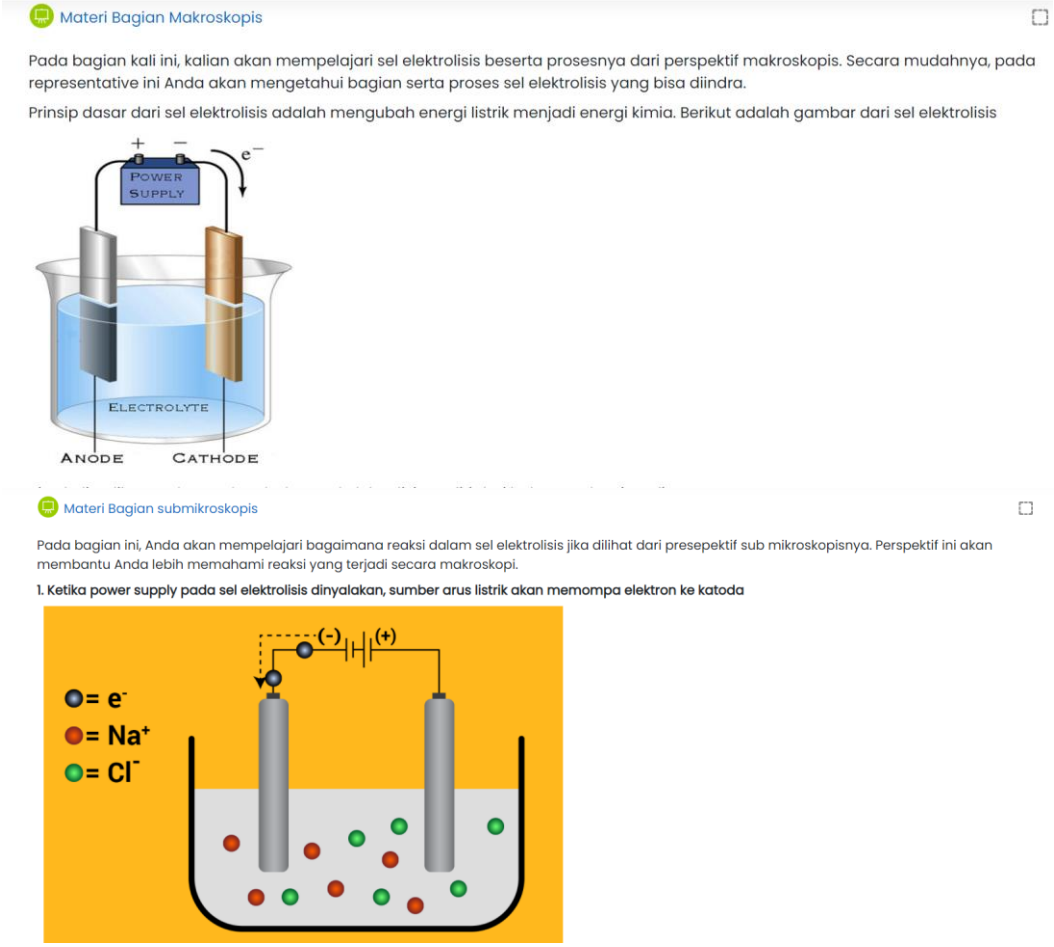
Table 5. Content validation results

No	Validity	Percentage (%)	Category
1.	Materials and Questions	97,5%	Very valid
2.	Three levels Representative	90%	Very valid

Make the material and questions must be following the selected basic competencies. Based on the feasibility test results above, it shows that interactive learning media with three representative levels of chemistry in the electrolysis cell material obtains a percentage of 97.5%, which is included in the very valid category in the aspects of the material and questions. Therefore, this interactive learning media on the element of chemistry is appropriate.

In the aspect of conformity with three levels of representative chemistry, the percentage obtained is 90% in the very valid category. This interactive learning media

was developed with three levels of representative chemistry so that it is very effective in improving student learning outcomes (Astuti et al., 2016). Based on the categories obtained from the results of content validity, the developed interactive learning media includes media that are feasible to use. Three levels of representative chemistry consist of macroscopic, symbolic, and submicroscopic (Talanquer, 2011). The three levels are interrelated. Therefore, it is crucial to include the three parts so students can clearly understand the material and there are no misconceptions about it (Tuysuz et al., 2011). The following illustrates the three levels of representative chemistry contained in interactive learning media in figure 2:



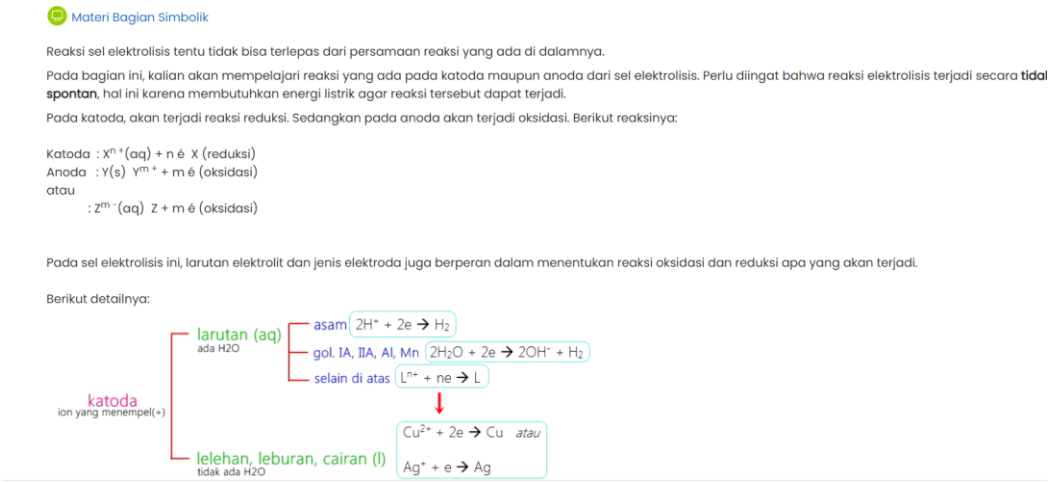


Figure 2. Illustration of Three Levels Representative Chemistry

Macroscopic representatives obtained observations of daily life and experiments in the laboratory. Submicroscopic representation can be explained by visualizing phenomena that occur at the macroscopic level through animation. While symbolic representation includes reaction equations, calculations, and chemical formulas (Gilbert and Treagust, 2009).

In Figure 2 above, a macroscopic representation is conveyed through pictures and laboratory experiments. Submicroscopic representations are presented in the form of animations, and symbolic representations are presented in equations for the reactions that occur.

Construct Validation

Validity test analysis of validity constructs can be seen from the suitability of the presentation, language, and graphic display. Table 6 is the result of the feasibility test of validity construct:

Table 6. Construct validation results

No	Validity	Percentage (%)	Category
1.	Presentation	85%	Very valid
2.	Language	83%	Very valid
3.	Graphic Display	83%	Very valid

Presentation Aspect

Criteria for the validity of the presentation relate to ease of use, the accuracy of the buttons, the coherence and completeness of the material contained in the interactive learning media. In the e-learning mediakimia.rnhlearning.com that is used, there are various learning features and instructions for use that are clear and complete. In addition, the delivery of images in the media must be meaningful so that students can understand

the material well. The presentation aspect of interactive learning media obtained 85%, including the very valid category. So that the interactive learning media in the presentation aspect is included in the type suitable for use. The following is a picture of instructions and uses of the question feature on mediakimia.rnhlearning.com in Figure 3 below:

Figure 3. Instructions and Questions After Animations in Interactive Learning Media

Language Aspect

The language aspects related to Indonesian spelling and the language used in mediakimia.rnhlearning.com are straightforward to understand. In writing, it is necessary to have good language so that readers can grasp the idea of the writing as a whole and not create misconceptions. In scientific works, the language used is a variety of written language that is clear, straightforward, and communicative, and standard so that readers can understand the contents easily (Indrastuti, 2018).

In validating the language aspect, the interactive learning media obtained a percentage of 83%, including the very valid category. It is shown that interactive learning media uses good, correct, straightforward language and does not cause misconceptions. Based on this percentage, interactive learning media is feasible to use in the language aspect.

Graphic Display Aspect

The media contains several things in the graphic display aspect, namely, readability of writing, color harmony, and arrangement of text and image layouts. The display of harmonious text and design that supports learning media content affects students' memory (Sujarwo and Oktaviana, 2017). Colors in harmony with the background will give an excellent impression to students because it will improve memory of the material to be

studied. The percentage of the feasibility of the display aspect is 83%, including the very valid category.

Interactive learning media is developed online on the website mediakimia.rnhlearning.com. The validation results show compatibility between the media design and the supporting components in it. So based on the graphic display aspect, the media is feasible to use. The image of the initial page display on the website that is used, which can be seen in Figure 4 below:

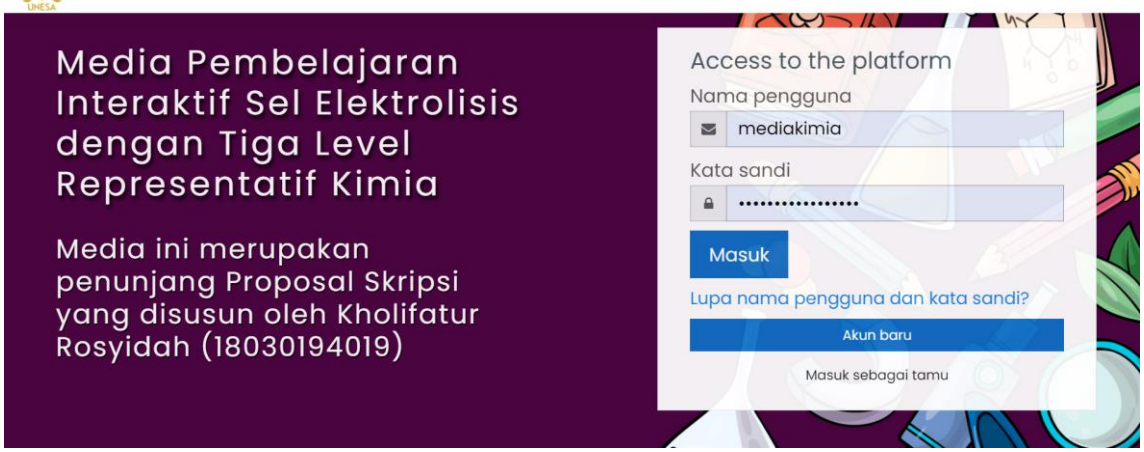
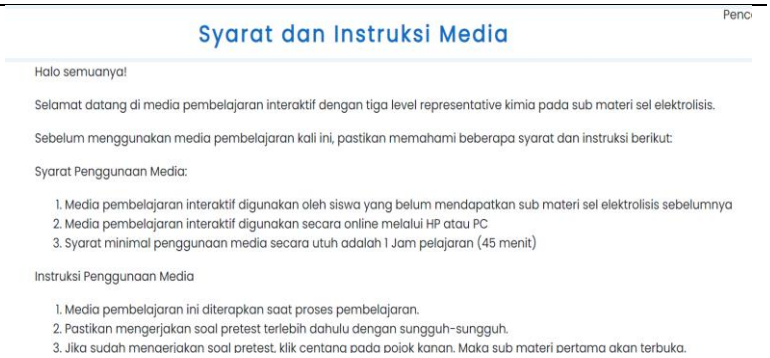


Figure 4. Graphic Display Interactive Learning Media

Design Revision

After being validated by two chemistry lecturers who are media and material experts, the media is revised based on the suggestions. The revision of the interactive learning media based on the validation results can be seen in Table 7 below:

Table 7. Revision Result

No	Suggestion	Results
1.	Add initial requirements and minimum time for using interactive learning media.	

▪ CONCLUSION

Based on the results of the analysis and discussion can be concluded that interactive media which has been developed is suitable for use to prevent misconceptions because of the three levels of chemical representation. It can be seen from the content validity and constructs with very valid categories. Moodle-based learning allows students to access media anywhere online with various animations and other supporting features. Next can be done for the trial phase with interactive media to the learning process to know the effectiveness of that media.

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