

# Validitas dan Praktikalitas E-modul Ikatan Berbasis Inkuiri Terbimbing Laboratorium Virtual Terpadu Untuk SMA

## *Validity and Practicality of Bonding E-module Guided Inquiry-Based Integrated Virtual Laboratory for High School*

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### ABSTRACT

*The increasingly rapid development of science and technology allows for innovation in various aspects of life, one of which is learning activities. Innovations in learning activities can take the form of teaching materials from printed to electronic. This research aims to develop a printed module into an e-module on chemical bonding material based on guided inquiry in an integrated virtual laboratory that is valid and practical for high school. The development model used is 4D. The e-module validation test was carried out by UNP lecturers and chemistry teachers. The practicality test was carried out by chemistry teachers and students. The research instrument is a validity and practicality questionnaire. The validation questionnaire was analyzed using the Aiken's V formula and the practicality questionnaire was analyzed using descriptive statistical percentages. Based on research, the average Aiken's V was 0.86 with a valid category. The practicality value of the e-module obtained from teachers and students was 85.2% and 90.1% respectively in the very practical category. Based on the results of research on the chemical bonding e-module based on guided inquiry integrated with the virtual laboratory for high school, the result is valid and practical.*

### KEYWORDS

*e-module, Chemical Bonding, 4D, Virtual Laboratory*

### ABSTRAK

Perkembangan ilmu pengetahuan dan teknologi yang semakin pesat memungkinkan adanya inovasi dalam berbagai aspek kehidupan, salah satunya adalah kegiatan pembelajaran. Inovasi dalam kegiatan pembelajaran dapat berupa bahan ajar dari bentuk cetak menjadi elektronik. Penelitian ini bertujuan untuk mengembangkan modul cetak menjadi e-modul pada materi ikatan kimia berbasis inkuiri terbimbing dalam laboratorium virtual terintegrasi yang valid dan praktis untuk SMA. Model pengembangan yang digunakan adalah 4D. Uji validasi e-modul dilakukan oleh dosen UNP dan guru kimia. Uji praktikalitas dilakukan oleh guru kimia dan siswa. Instrumen penelitian berupa angket validitas dan praktikalitas. Angket validasi dianalisis dengan menggunakan rumus Aiken's V dan angket praktikalitas dianalisis dengan menggunakan statistik deskriptif persentase. Berdasarkan penelitian, diperoleh rata-rata Aiken's V sebesar 0,86 dengan kategori valid. Nilai praktikalitas e-modul yang diperoleh dari guru dan siswa masing-masing sebesar 85,2% dan 90,1% dengan kategori sangat praktis. Berdasarkan hasil penelitian terhadap e-modul ikatan kimia berbasis inkuiri terbimbing terintegrasi laboratorium virtual untuk SMA/MA diperoleh hasil valid dan praktis.

### KATA KUNCI

*e-modul, Ikatan Kimia, 4D, Laboratorium Virtual*



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## 1. INTRODUCTION

The rapid development of science and technology makes it very easy to enter all aspects of life except in the field of education. The development of technology can transform the learning process centered on the teacher into a learning process centered on the student participant where this learning process can encourage the student to become more active in discovering knowledge independently.

Teachers have a very important role in planning learning activities. In the learning process, teachers usually use the learning model. One of the learning models used is the guided inquiry. Inquiry-guided is a learning model in which learning activities emphasize students the process of searching and finding. Guided inquiry learning can improve student activity<sup>1</sup> and critical thinking skills of pupils<sup>2</sup>. According to Hanson The guided inquiry steps consist of 1) orientation; 2) exploration and conceptual formation; 3) application; 4) conclusion<sup>3</sup>.

The inquiry learning model can be applied in teaching materials such as modules. Science and technology cause the change of teaching material from printed form to electronic formats like modules into e-modules<sup>4</sup>. E-modules are self-contained teaching materials that are systematically structured to learning goals in an electronic format that contains animations, audio, and video that make learning effective, efficient, and enjoyable<sup>5</sup>. E-modules were rated more interactive because students can perform evaluations, and can be used via a computer or smartphone<sup>6</sup>.

Based on the observations in SMAN 2 Field, MAN 2 Field, and SMAN 1 Umbrella Foot, the pupils experienced difficulties in some difficult-to-understand material and material of a fictional nature. Students can only repeat the definitions of the terms that exist in chemical binding materials but do not properly understand the actual meaning or can be said that students have not yet been able to apply the concept of chemical bonding and clamps still depend on the skill<sup>7</sup>. The e-module teaching materials are used to increase the motivation and interest of students in learning as they can be accessed through gadgets and computers<sup>8</sup>.

Practical activities on chemical binding materials cannot be carried out due to time constraints and reduced learning hours. The result is difficulty in understanding this material. With an e-module containing an animation or a virtual laboratory, it is hoped that it will be an alternative for students to continue practicing. A virtual laboratory is a system used to support a conventionally run practice. Virtual labs allow students to experiment repeatedly<sup>9</sup>. Virtual laboratories can improve the safety and safety of practicum work because pupils do not interact directly with hazardous chemicals<sup>10</sup>.

The research that has been carried out shows that the e-modul based on guided inquiry integrated with virtual

laboratories on chemistry subject has very high validity and practicality values<sup>11</sup>. The results of the effectiveness test obtained an N-gain value of 0.801 which stated that the e-module was effective in improving the learning outcomes of students with higher experimental classes than the control classes<sup>12</sup>. It states that the e-modules obtained are already worthy of use in chemistry learning activities both in class and in practice.

Based on the above background, it is developed a teaching material-based inquiry guided chemical material (namely, chemical bonding) integrated virtual laboratory in the form of an e-module. This research aims to know the validity and practicality of the e- module developed.

## 2. METHOD

The type of research used is research and development or Research and Development (R&D) teaching material in the form of e-modules for learning models inquiry guided integrated virtual laboratory and assessments for the level of validity and practicality of the resulting product. The development model used is the 4D development model (Define, design, Development, and Dissemination)<sup>13</sup>. The implementation of this development research is only done until the development stage or development stage. The subjects of this investigation are 18 students.

The validation test assessment is obtained from the validation sheet to the validator which is then analyzed using Aiken's V formula<sup>14</sup> as follows. V is the index of the rater deal, the S score set by each rater is the lowest in the category used or  $S = r$ , with r being the rater selection category score and The lowest score in the deduction, n the number of rater and c is the highest validity number.

Analysis of practicality data obtained from elevated teacher and pupil responses using percentage formula<sup>15</sup> as follows.

$$P=f/N \times 100\%$$

With P representing the practicality of the product, F is the total value obtained from the lift and N is the maximum value on the lift.

## 3. RESULT AND DISCUSSION

### 3.1. Define

#### 3.1.1. Front End Analysis

As a result, it was found that students were still experiencing difficulties in learning chemical binding materials because of many difficult and difficult terms, and practicum activities were not carried out due to limited learning time.

#### 3.1.1. Student Analysis

Based on the theory of Piaget's cognitive development, the age level of high school students entering the operational stage<sup>16</sup>.

Students can think abstractly, have the ability to think hypothetically and have the capacity to attract information<sup>17</sup>. Therefore, the teaching materials developed use the guided inquiry learning model to help students discover concepts through models and data obtained during laboratory activities.

### 3.1.2. Task Analysis

This phase analyzes KD 3.5 and KD 4.5 and then formulates the learning achievement indicators to be achieved. The material in this study is chemical bonding for class X using a guided inquiry model where students conduct orientation activities, explore and form concepts, and applications, and conclude.

### 3.1.3. Concept analysis

Concept analysis is obtained by identifying the main concepts contained in the material and then arranging them in a structured manner. The main concepts in this material are the octet rule, ionic bonds, covalent bonds, Lewis structures, coordination covalent bonds, and metallic bonds.

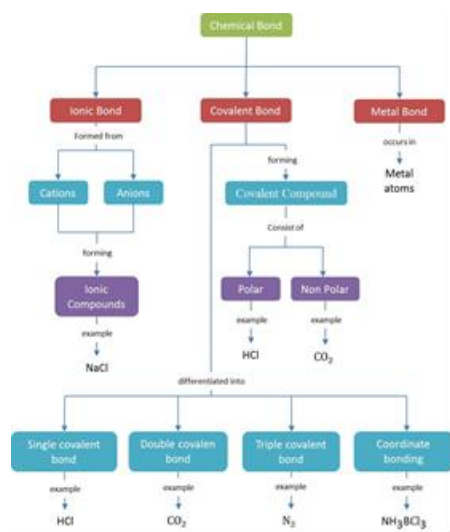


Figure 1. Concept map of chemical bonding material

### 3.1.4. Analysis of Learning Objectives

The purpose of learning through an inquiry learning model is to guide students to compare ion bonds, covalent bonds coordination covalents, and metal bonds as well as their relationships with the properties of substances.

Based on basic competencies 3.4 and 4.4 concerning chemical bonding, learning objectives can be determined, namely through a guided inquiry model by exploring information from various learning sources, simple investigations, and processing information, it is hoped that students will be actively involved during the

teaching and learning process, have a curious attitude, thorough in making observations and responsible in expressing opinions, answering questions, providing suggestions and criticism. Apart from that, you can compare ionic bonds, covalent bonds, coordination covalent bonds, and metallic bonds and their relationship to the properties of substances, as well as design and carry out experiments to show the characteristics of ionic compounds and covalent compounds based on several physical properties.

## 3.2 Design

This phase aims to design the e-module to be developed. The design of this e-module requires several applications such as Microsoft Word 2010 to create drafts of e-modules, google form for learner answers sheets, flip PDF Professional to unite all the components of the e-Module, and Crocodile which is a virtual laboratory application. The selection of writing format includes teacher guidelines, learner activity sheets, worksheets, worksheet keys, evaluation sheets, and evaluation leaf keys<sup>18</sup>.

## 3.3 Develop

### 3.3.1. Validity test

The validity test was conducted by seven validator experts, consisting of four UNP lecturers and three chemistry teachers, with the components to be evaluated: content, presentation, language, and graphics.<sup>19</sup> The validation was carried out by seven validators and the results were analyzed using Aiken's V formula.

The data processing results obtained from the evaluation of the validity of the e-module on each of the composers can be seen in Figure 2 below.

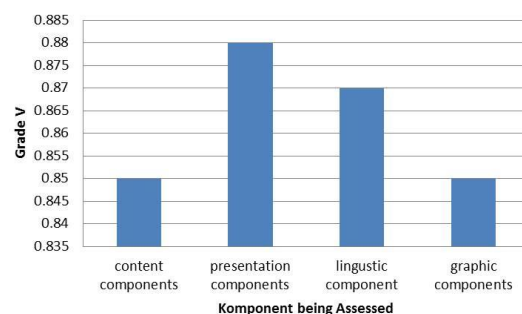


Figure 2. E-module validation test results

Through Figure 2 you can see the total average value of 0.86 with a valid category. This proves that the material developed is valid but there are still some suggestions for improvement from the validator<sup>20</sup>. Subsequently, the revisions are carried out according to the recommendation of the validator.

### 3.3.2. Revision

Some suggestions for e-module improvements include improvements on the cover that should show the binding of the material, examples of images that should not display trademarks, instructions to work the task in clear, adding the writing of the lead structure for the compound, inaccurate sequence of achievement indicators, animation improvements, and adding “click to answer” buttons.

### 3.3.3. Practicality test

The practicality of an inquiry-based chemical bonding e-module guided by an integrated virtual laboratory can be seen from the product clothing of the test results related to the practicality and implementation of the developed product. The practicality data is obtained from the elevation response of teachers in the field of chemistry studies and the elevation of students using the percentage formula. The components of practicality are ease of use, time efficiency, and benefits<sup>21</sup>. The result of the data processing of the lifting evaluation of the practicality of the e-module is shown in Figure 3.

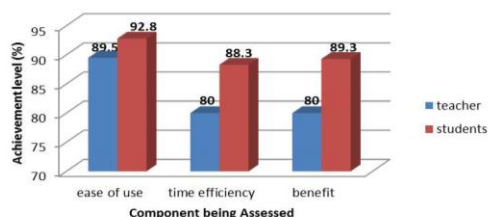


Figure 3. Results of the practicality test of the e-module from the teacher and student lift

The results of the practicality test of the components of ease of use of the teaching material through the teacher's lift response can be on average 89.5% and through the elevator students can on average 92.8%. The percentage is in the very practical category. This is due to the e-module that has developed an overview of the instructions, steps and materials easily understood by teachers and learners.

The practicality test results of the time efficiency component are based on an average teacher response lift of 80% and an average student response lift of 88.3% where this percentage is in the very practical category. This proves that the specified e-module can help spread activities become more efficient. The purpose of the teaching material is to help the teacher in delivering the material so that the reading time becomes more efficient<sup>22</sup>.

The results of the benefit component practicality test based on the teacher's response lift can be an average of 80% and the respondent elevation of the pupil in the average of 89.3% with a very high category. It states that the e-module can support the role of the teacher as a facilitator, help the pupils understand the material and learn independently, and make lessons enjoyable<sup>23</sup>.

Based on the evaluation of four teachers obtained an overall average of 85.2% with a very practical category. The data processing results of the evaluator raised the practicality of e-modules from the pupil's average of the total 90.1% with a highly practical category. This shows that the e-modules developed are practical or easy to use by teachers and pupils.

## 4. CONCLUSION

Based on the research that has been done, it can be concluded that the inquiry-based chemical binding e-module guided integrated virtual laboratory for high school with the developed 4D development model is valid and practical.

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