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ARTIKEL RISET

Pengembangan E-Instrumen untuk Menguji Model Mental Siswa pada Materi Larutan Elektrolit dan Non Elektrolit

The Development of E-Instrument to Test Students' Mental Models on Electrolyte and Non-Electrolyte Solutions

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ABSTRACT

The purpose of this study is to design an instrument that can be used to determine students' mental models in electrolyte and non-electrolyte solutions. Students' do not have complete understanding of electrolyte and non-electrolyte solutions topic. It takes an instrument that can measure students' mental models, which can then be used to find out why students do not have complete understanding of electrolyte and non-electrolyte solutions topic. The research method used is the RnD method with a 4D model. The research steps consist of define, design and development. The results of this study are e-instruments that can be used to measure students' mental models on electrolyte and non-electrolyte solutions. The average results of the instrument's feasibility from material experts and teacher experts were 89% and 83%, namely worthy with very good predicate and good predicate. These results indicate that the designed instrument is feasible to use. The instrument designed only reached the validation stage due to lack of time in research.

KEYWORDS

Electrolyte, Instrument, Mental Models, Non-Electrolyte

ABSTRAK

Tujuan dari penelitian ini adalah mendesain instrumen yang dapat digunakan untuk mengetahui model mental siswa dalam materi larutan elektrolit dan non elektrolit. Siswa tidak memiliki pemahaman yang utuh terkait materi larutan elektrolit dan non elektrolit. Dibutuhkan suatu instrumen yang dapat mengukur model mental siswa, yang kemudian dapat digunakan untuk mengetahui penyebab siswa tidak memiliki pemahaman yang utuh terkait materi larutan elektrolit dan non elektrolit. Metode penelitian yang digunakan adalah metode RnD dengan model 4D. Langkah penelitian terdiri dari *define*, *design* dan *development*. Hasil dari penelitian ini berupa e-instrumen yang dapat digunakan untuk mengukur model mental siswa pada materi larutan elektrolit dan non elektrolit. Rata-rata hasil kelayakan instrumen dari ahli materi dan ahli guru adalah 89% dan 83% yaitu layak dengan predikat sangat bagus dan predikat bagus. Hasil tersebut memberikan arti bahwa instrumen yang didesain layak untuk digunakan. Instrumen yang didesain hanya sampai pada tahap validasi karena kurangnya waktu dalam penelitian.

KATA KUNCI

Elektrolit, Instrumen, Model Mental, Non Elektrolit

1. INTRODUCTION

Chemistry is a science that has abstract, complex, hierarchical, multidisciplinary and involves analytical operations. Chemistry is a relatively complicated science[1]. One of the topics in chemistry is an electrolyte and non-electrolyte solution material learned in class X SMA[2]. This topic contains factual, conceptual, and procedural knowledge[3]. The concept is the idea of a discussion[4]. The concepts in electrolyte and non-electrolyte topic includes the concept of solution, electrolyte, and the concept of non-electrolyte. Electrolyte and non-electrolyte solution topic has characteristic[5]. Need correlation between the three chemical representations (macroscopic, submicroscopic, and symbolic) to understand the topic. Students' understanding of the three representations is also called a mental model[6]. Students' mental models have a relationship with students' understanding of representations[7]. The higher the student's mental model, the higher the understanding of the representation.

Mental models are concepts that are still ambiguous in the minds of students[8]. Mental models are divided into 2, scientific mental model and alternative mental model. A scientific mental model is a mental model in students obtained from their knowledge using a scientific model[9]. An alternative mental model is a mental model in students obtained from their knowledge but does not using a scientific model[10].

According to Suari[11] students do not have complete understanding electrolyte and non-electrolyte solutions. The research results: 63.85% partially correct answers, 19.63% misconceptions answers, and 3.63 % no response.

An evaluation is needed to measure students' mental models, namely an assessment instrument. An assessment instrument is a tool used to measure an object[12]. Development of technology has an impact on all aspects of life, including the world of education. Learning in the 21st century must be integrated with increasingly sophisticated technological developments[13]. Likewise, the evaluation carried out must utilize technology appropriately[14]. One of the innovations that can be done in developing learning evaluations is the development of instruments with online media called e-instruments. The purpose of this research is to design and test the feasibility of electrolyte and non-electrolyte solution instruments to determine students' mental models in the electrolyte and non-electrolyte solution. The product of this research is an instrument to test students' mental models which can be used for evaluation of previous learning.

2. METHOD

The research method used is research and development[15], so that a product will be produced is an e-instrument. The research model used is 4D. The research model 4D is carried out in 4 stages, define, design, development and disseminate[16]. In this research, the development model stage is limited to the validation stage. The research implementation activities include, define, design and development.

2.1. Define

The steps taken at the define stage are the analysis of learning needs in development of e-instruments: analysing the basic competencies of topic, identifying student problems in understanding electrolyte and non electrolyte solution topic, identifying weaknesses in assessment instruments that have been used.

2.2. Design

Preparation of e-assessment instruments that have been used to test students' mental models and preparation of validation sheets. The design for the assessment e-instrument includes: determining assessment indicators, making questions consisting of macroscopic, submicroscopic and symbolic aspects. The assessment e-instrument to test students' mental models consists of 5 questions, each of which includes macroscopic representations, submicroscopic representations, and symbolic representations. The design of the validation sheet includes a validation sheet for material experts and teacher experts. The designed instrument is validated by five validators, including three chemistry teachers as expert teacher validators and two chemistry lecturers as material expert validators.

2.3. Development

The development stage aims to revise the e-instruments that have been designed in the previous stage. Development is carried out according to suggestions from material experts and teacher experts.

3. RESULT AND DISCUSSION

3.1. Validation Results

The instrument's design aims to measure students' mental models in electrolyte and non-electrolyte solution topic. However, the research carried out only reached the validation stage due to the lack of time in this study. The instrument design was then tested for validity by five validators. The data obtained are qualitative and quantitative data was then analysed on average and tested for feasibility. Analysis of the average value using the formula in Equation 1. After obtaining the average results, then the feasibility is tested using Table 1. This information can be seen in Table 2.

$$\bar{X} = \frac{\Sigma \, the\ value\ obtained}{the\ overall\ value} \times 100\% \quad \text{... Equation 1.}$$

The first is expert teacher validation, given to 3 chemistry teachers, and the results obtained are 43, 43, 47. Then the value generated is calculated the average value with the above formula, so that the results are 86%, 86%, 94%.

The second is expert material validation. The material expert validators are two chemistry lecturers from the Faculty of Science and Technology UIN Walisongo, and the results are 61 and 63.

Table 1. Average Feasibility Test Table.

Scale %	Eligibility Criteria
85-100	Deserves a very good predicate
65-84	Deserves a good predicate
45-64	Eligible with the predicate enough
0-44	Not feasible

Table 2. Table of instrument feasibility.

Validation Aspect	Result	Average	Description
Experts teacher validation	V1: 86% V2: 86% V3: 94%	89%	Deserves a very good predicate
Experts material validation	V1: 84% V2: 81%	83%	Deserves a good predicate

Then the value obtained is calculated the average value with the above formula, so that the results obtained are 81% and 84%. The results of the calculation of the validation of material experts and teacher experts then calculate the average, then matched with Table 1 to be tested for feasibility.

The average teacher expert validation results obtained a value of 89%, and the average material expert validation results obtained 83%. This shows that the designed instrument is feasible to use.

3.2. Description of Instrument's Design

The design of the student's mental models assessment instrument is in the form of 5 essay questions. Each item contains questions from macroscopic, submicroscopic, and symbolic aspects. A sample of an essay question can be seen on Table 3. Mental chemistry models are closely related to three levels chemical representation. Relation between mental models and chemical representations can be seen in the Figure 1.

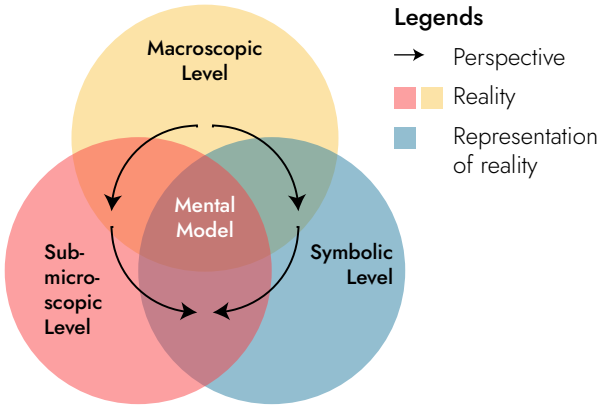

Figure 1. Relation between mental models and chemical representations.

3.3. Description of Validation Sheets

The validation sheets include 2 types: validation sheet for material experts and teacher experts. The validation sheet for teacher experts is construct validity. Construct validity contains ten statements about the designed instrument is able to measure students' mental models on electrolyte non electrolyte topic with a rating scale of 1-5 (strongly disagree to strongly agree). Some statements in the instrument: The instrument designed can be used to test students' mental models on electrolyte and non-electrolyte solution topic, The form of the questions in the instrument is easy to understand and easy to read, Sentences in the instrument do not cause multiple meanings, The language used is in accordance with the level of student development, The use of notation, symbols,

Table 3. A sample of the essay question.

Reading materials

When in the kitchen, we must be familiar with salt. Salt is one example of an electrolyte solution that exists in everyday life. Salt is food flavoring and food preservative.

Questions

A. Based on the reading, describe the physical properties (including physical form, phase, color, smell, and taste) of salt!
B. Explain the main constituents of salt that you know along with the reactions that occur in the manufacture of salt!
C. Describe the molecular formula of salt!

Explanation

The form of the questions is designed in such a way because the mental model is students' understanding of chemical representations, so that students' mental models can be described through their understanding of chemical representations (5). The question part A is a macroscopic aspect because it asks about something that can be observed or felt with the five senses. The question part B is a submicroscopic aspect because it asks about chemical aspects that cannot be seen or felt by the five senses. The question part C is a symbolic aspect because it asks about chemical formulas. Students' mental models can be measured through students' answers when given questions that includes three levels of representation.

and the units correctly, The instrument contains questions that are systematically arranged, The instrument contains questions with various levels of difficulty. At the end of the instrument there is also a column of criticism and suggestions.

The material expert validation sheets for lecturers contains fifteen statements. The statement includes of suitability instrument with electrolyte non electrolyte topic with rating scale of 1-5. Some statements in the instrument: Questions according to electrolyte and non-electrolyte topic, questions according to macroscopic representations, questions according to submicroscopic representations, questions in everyday life that are interesting to study. At the end of the instrument there is also a column of criticism and suggestions.

4.CONCLUSION

The research method used is the RnD method with a 4D model. The research steps include define, design, and development. Validation results from teacher experts: 43, 43, 47. Validation results from material experts: 61 and 63. The validation values obtained were then calculated on average and measured for feasibility so that the results were 89% and 83% with a very good and good predicates.

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