Validity and Practicality of The Salt Hydrolysis Electronic Module Based on Structured Inquiry with Interconnection of Three Levels of Chemicals Representation

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Abstract. Salt hydrolysis is one of the chemical’s material with the associated aqueous reaction in solution. The material is difficult to understand for students. Based on interviews, the learning process has not been interconnected by three levels of chemicals representation. The purpose of the research to decide on the validity and practicality of the salt hydrolysis electronic module based on structured inquiry with the interconnection of three levels of chemicals representation. The method of research was used by Research and Development of Plomp model. The research instruments are used by sheets validation and sheets practicality. The electronic module was validated by 4 experts. The practicality of the electronic module was checked by 2 chemistry teachers and 60 students at two High Schools in Padang City. Validity and Practicality were analyzed by utilizing Cohen’s Kappa Statistic. The outcomes of validation showed that the electronic module had an almost perfect strength of agreement with a Kappa was 0.87. The practicality level had substantial strength of agreement with a Kappa was 0.80 for the student’s reaction and also almost perfect strength of agreement with a Kappa was 0.85 for the teacher’s reaction. Therefore, the result electronic module of salt hydrolysis can be used as a good alternative for teaching-learning chemistry in high school.

1. Introduction

Chemistry is a scientific discipline that takes about the composition, properties, the matter changes, and the energy changes [1]. Chemistry is not easy for students to understand, because the characteristics of chemistry are abstract [2]. The salt hydrolysis is one of the difficult abstract parts in chemistry that very hard to understand for students [3], [4], [5]. Salt hydrolysis is one of the chemical material with an associated aqueous reaction in solution [6]. Salt hydrolysis studies generally associate is only two levels of representation, specifically macroscopic and symbolic level, while submicroscopic levels are rarely applied [7], resulting in the students are hard to grasp the concept. The phenomenon of the macroscopic level can be clarified via submicroscopic levels [8], [9]. A complete grasp of the chemistry concept can be achieved by using three levels of chemicals representation and interconnecting it [10], so understanding the concept becomes better [11], [12]. This case will facilitate the meaningful learning of students [11].
Efforts that can assist students to interpret the concept of salt hydrolysis entirely may be made by equipping education materials with three levels of chemicals representation. Grounded on the outcomes of debriefing sessions with three High Schools in Padang City, the subject utilized nowadays does not fully apply three levels of chemicals representation. An electronic module is one of the teaching substances that may help this shortcoming. This teaching material is a transformation of modules conventional with combined Kvisoft Flipbook Maker Software systematically structured and detailed so that it is innovative because it features interesting, completely, interactively teaching materials (equipped with video, audio, animation) and has cognitive functions [13], [14], [15], [16]. The preparation of electronic modules is adapted to the learning model suggested by Permendikbud No. 22 of 2016, one of which is a structured inquiry learning model [17]. This model is following the approach of constructivism in which knowledge is not distributed immediately by the teacher to the students, on the other hand, can give freedom for the students to construct their knowledge [18]. The learning structured inquiry can help the development of cognitive’s aspects, attitudes, and skills. The balance of these three aspects can give the result more meaningful learning [19].

The inquiry learning model is consists of several levels, namely confirmation inquiry, structured inquiry, guided inquiry, and open inquiry [20], [21]. The four levels are divided by the teacher implicated in teaching-learning to process [22]. The selection of levels inquiry suitable as a learning model should be taken based on the students' capability to think scientifically which the difficulty level of the materials taught. The salt hydrolysis material is difficult [6], [4]. Therefore, the utilization of a structured inquiry model may be a beneficial solution to improve students' capability to grasp the material. This is in line with Bell’s, et al. phrase [23] that students' requirement phases to achieve a scientific level of thinking that must start from the bottom to the top level of inquiry. Based on the preliminary studies performed through interviews at three High Schools in Padang, the inquiry structured learning models, has never been used in hydrolysis salt learning. Therefore, structured inquiry-based e-module teaching materials are developed by applying research by the interconnection of three levels of chemical representation on valid and practical salt hydrolysis materials. The research intends to decide the validity and practicality of the salt hydrolysis electronic module based on inquiry structured with the interconnection of three levels of chemicals representation.

2. Research Methods
This kind of study was Research and Development (R&D). The development model which was utilized in this study has developed the Plomp model by Tjeerd Plomp. This model was divided into 3 main phases, namely: (1) preliminary research, (2) prototyping phase, and (3) assessment phase [24]. The syntax in this study was: 1) Preliminary research consists of the analysis of problems and teacher’s need, analysis of curriculum, analysis of the concept, and analysis of students; 2) The prototype manufacturing phase divides of I, II, III, and IV which was continued by a formative appraisal; 3) The assessment’s phase was decided by practicality check and effectiveness check. This study was restricted only by the validity and practicality checks of development models.

The research instrument divides of validity sheets and practicality sheets of questionnaires. The questionnaire's validity was validated by 4 experts, while questionnaires practical were checked to 2 chemistry teachers and 60 students in Senior High School 3 and 7 in Padang. Validated questionnaires are useful in assessing electronic modules that are made from sections of content components, construct components, linguistic components, and graphic components. Electronic modules validated will be repaired by following the advice of the experts. Practicality questionnaires are helpful to determine the practicality of developed electronic modules from sections of attractiveness, ease of use, time efficiency, benefits, and scientific truth. The result gained were examined by utilizing Cohen’s Kappa statistic [25].

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\text{Cohen’s Kappa (k) = } \frac{(p - p_e)}{(1 - p_e)}
\]  

(1)

Information:

k = Cohen’s Kappa represents a product validity/practicality
\( \rho \) = The realized proportion  
\( \rho_e \) = Unrealized proportion

| Kappa Statistic | Strength of Agreement |
|-----------------|-----------------------|
| 0.81–1.00       | Almost Perfect         |
| 0.61–0.80       | Substantial            |
| 0.41–0.60       | Moderate               |
| 0.21–0.40       | Fair                   |
| 0.00–0.20       | Slight                 |
| \( \leq 0.00 \) | Poor                   |

3. Results and Discussion
The results of structured inquiry-based electronic modules with the interconnection of three levels of chemicals representation may be divided into; 1) preliminary research, (2) prototyping phase, and (3) assessment phase.

3.1. Preliminary Research
At this phase, several analyses are done, namely an analysis of problems and teacher's needs, analysis of students, analysis of curriculum, and analysis of the concept. The results obtained at this stage can be the basis for developing the e-module. The results at this stage are as follows:
1. The problems which students always face in the salt hydrolysis material are: a) Students memories of this concept are only stored in short term memory so students are easy to forget the concept, b) Students consider salt hydrolysis material is difficult because it is dominated by calculations, c) According to the teaching materials used, students still have difficulty in understanding the submitted materials teaching because the available materials teaching has not yet direct students to find the concept, d) The ability of students to solve higher-order thinking skills are still lacking.
2. The materials teaching used are not equipped with three levels of chemical's representation
3. Teachers and students expect an interesting and easy-to-understand learning medium.

3.2. Prototyping Phase
Grounded on the outcomes of the initial investigation phase, next the initial design of the electronic module was carried out. The result of the initial design of this electronic module is named prototype I. This prototype includes electronic module elements namely: Cover, foreword, table of contents, list of tables, list of pictures, instructions for use of electronic modules, core competencies, basic competencies, competency achievement indicators, learning objectives, concept maps, introductions, activity sheets, worksheets, evaluation questions, key answers, and references. Furthermore, a self-evaluation was held out on the prototype I to correct mistakes that looked like typos, image misuse, the fullness of electronic module elements, and the appropriateness of electronic modules with a structured inquiry learning model phases. Overall, there have been several mistakes, namely typos, misrepresentation of image captions, layout design, use of submicroscopic video, and terminology usage in concept delivery. A view of the cover and the content of the electronic module as shown in Figure 1 and Figure 2.
The outcome of repairing self-evaluation resulted in prototype II. On prototype II, expert validation and one-to-one evaluation were carried out. The electronic module that has been developed is validated for 4 experts and produces an almost perfect strength of agreement (k=0.87). The outcomes of the scrutiny as shown in Table 2.

| No | Assessment Aspects | k   | Strength of Agreement |
|----|---------------------|-----|-----------------------|
| 1  | Content             | 0.88| Almost Perfect        |
| 2  | Construction        | 0.84| Almost Perfect        |
| 3  | Language            | 0.86| Almost Perfect        |
| 4  | Graphics            | 0.89| Almost Perfect        |
|    | Average             | 0.87| Almost Perfect        |

Premised on Table 2, the content of the components displays an almost perfect strength of agreement (k=0.88). This designates that the electronic modules developed are following the core competencies, basic competencies, competency achievement indicators, and learning purposes that you want to accomplish. The contents of the electronic module are also present the concept of using three levels of scientifically correct chemical representation. The product is categorized as valid from the content if the product is reliable the curriculum [26] and appropriate to the science [24]. The construct components has also an almost perfect strength of agreement with an acquisition of the Kappa is 0.84. This result shows that there is a stage of appropriateness between the presentation of electronic modules and the synapses of structured inquiry learning models. The product is categorized as valid if the construct component is well-related [24].

In the language components, the validity of the electronic module has a Kappa is 0.86 with an almost perfect strength of agreement. This designates that the language used is good and correct in Indonesian rules. One of the electronic module's features is good if it is user-friendly. Its mean electronic modules...
that are developed by using language is simpler to understand, uncomplicated, and informative [14]. The result of the graphic components has an almost perfect strength of agreement with a Kappa is 0.89. This shows that the electronic module which is developed has an attractive design. One of the aspect quality of electronic modules is the appeal [27] that can increase students’ learning will be interested. The appearance of images, videos, and symbolic levels in electronic modules can assist students to grasp the concepts learned [15]. The repairs are given by experts as shown in Figure 3 and Figure 4. Experts recommend creating more animated interesting videos and according to scientific rules.

The next phase was evaluated one-to-one by interviewing 3 students in Senior High School 3 and 7 in Padang with various capabilities divided into high level, medium level, and low level. There are 3 points analyzed in this phase: clarity, appeal, and obvious error. Grounded on the answers of the debriefing session obtained information that the substance shown in the e-module is self-explanatory and the layout design is also interesting. Even though there are still some typos and the video display is poorly understood. At the period of the debriefing session, it was obtained that a low student's level was further hard to invent the hypothesis.

Correction from prototype II resulted in prototype III. In this prototype was carried out a small group evaluation that purposes to see the practicality of electronic modules before was being examined in large groups. In this phase, the electronic module was checked on 6 students divided into high level, medium level, and low-level capabilities in one procedure session learning. Overall, the practicality has a Kappa is 0.82 with an almost perfect strength of agreement. Subsequently, conducting a small group appraisal obtained prototype IV, which then carried out a large group test.

3.3. Assessment Phase
This assessment phase purposes to seem at the practicality and effectiveness of electronic modules tested on large groups (field tests). Practical data are obtained from the provision of student and teacher questionnaire reactions. The overall practicality score of the students’ and teachers’ reaction...
The results’ practicality of teacher and student questionnaires reaction as shown in Table 3.

| No | Aspects         | Cohen’s Kappa (Teacher) | Cohen’s Kappa (Student) |
|----|----------------|-------------------------|-------------------------|
| 1  | Attractiveness | 0.87                    | 0.81                    |
| 2  | Ease of use    | 0.84                    | 0.79                    |
| 3  | Efficiency     | 0.84                    | 0.80                    |
| 4  | Benefit        | 0.85                    | 0.80                    |
|    | Average        | 0.85                    | 0.80                    |

An electronic module can be categorized as practical if the consumer was easy to apply the electronic module as required. The practicality of substance teaching is divided into the aspects of attractiveness, ease of use, efficiency, and benefit [28]. Premised on Table 3, be produced aspects of the appeal of electronic modules with a Kappa are 0.87 for teachers and 0.81 for students who show an almost perfect strength of agreement. It shows the electronic modules are intriguing for students to understand. The utilization of an appealing layout design will improve student's motivation learning [29]. In conditions of ease of use of electronic modules, the result shows the electronic module is simple to apply. The responses from teachers and students show an almost perfect and substantial strength of agreement with Kappa are 0.84 and 0.79. One of the characteristics of the electronic module is user-friendly. This indicates the electronic module is simple to practice, every presentation of the concept is very useful, the user can easily provide the reply and access in question, the language used is good and correct in Indonesian rules [14].

In terms of time, the efficiency of electronic modules developed also has an almost perfect strength of agreement with Kappa is 0.84 for teachers and show a substantial strength of agreement with a Kappa is 0.80 for the student. This intimates that the learning process by using an electronic module to understand the material electronic module can preserve the learning period. Studying by applying electronic modules can create students' time further effectively and able to study independently [27]. In terms of benefits, electronic modules developed have an almost perfect strength of agreement with Kappa is 0.85 from teachers and show a substantial strength of agreement with a Kappa is 0.80 for the student. It means that the electronic module worthwhile for its consumers. This electronic module is created to make students easier to realize the material which is presented by the interconnection of three levels of chemicals representation and also have exercise evaluation to help students measure the level of self-concept knowledge according to the content of the electronic module [30]. The usage of electronic modules in learning can assist students to enhance grasp, active in educational activities, and to get concepts individually.

4. Conclusions
The development of the salt hydrolysis electronic module based on structured inquiry with the interconnection of three levels of chemical’s representation has an almost perfect strength of agreement for the validation result with Kappa is 0.87. The practical results are an almost perfect strength of agreement with a Kappa is 0.80 for the students and a substantial strength of agreement with a Kappa is 0.85 for the teachers. This designates that the salt hydrolysis electronic module developed can be applied as one of the teaching materials in the teaching-learning process of the salt hydrolysis material.

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