Developing an Interactive Chemistry E-Module for Salt Hydrolysis Material to Face the Covid-19 Pandemic

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Abstract. This study aimed to develop an interactive chemistry e-module for learning chemistry for salt hydrolysis material at senior high school (SMA/MA). The research method utilized in this study was Research and Development (R&D) by using Plomp model. This study was divided into three phases: (a) preliminary research phase; (b) the development or prototype phase; and (c) assessment phase. E-module product was developed by using Kvisoft flipbook maker application. The results of this study revealed that the chemical e-module for salt hydrolysis material was declared to be very valid. The analysis results of the responses from teachers and students showed that e-module for salt hydrolysis material included in the criteria of attractive and this e-module received positive responses from teachers and students. This implies that this interactive e-module product is recommended to be used for online chemistry learning for salt hydrolysis material during the period of Covid-19 pandemic.

1. Introduction
The 21st century is marked by the development of information technology [1]. The integration of technology in all aspects of life leads that human interaction increasingly depends on technological developments, such as computers and the internet [2]. Changes occurred in the 21st century are very massive and it is difficult to predict those changes in all aspects of life, for example: the fields of knowledge, economics, transportation, technology, communication, education, and others [3]. Furthermore, the 21st century learning combines knowledge, thoughts, innovation skills, media, literacy, Information and Communication Technology (ICT) as well as real life experiences in the learning process [4].

In addition, the 21st century skills are not only understood by teachers but also must be directly practiced in the learning process so as to stimulate the students to focus on integrating the 21st century skills [5]. The 21st century refers to a century of science and technology (science and technology); therefore, we are faced an era when science and technology are changing and developing very rapidly [6]. Then, advances in science and technology influence the use of teaching aids at schools and other educational institutions. At this time, learning at schools begins to be adjusted to the development of science and technology, which results in changes and shifts in the educational paradigm. In other words, information technology has become an important role in the field of education [7]. The use of information technology in learning has become a necessity as well as a demand in the era of globalization [8]. However, the implementation of learning science including chemistry in high schools is still ineffective because of the limitations of learning materials and resources that can increase students’ enthusiasm at schools because most of the materials require suitable media in order to increase the students’ understanding.
Chemistry Learning is a branch in natural sciences that studies the composition and properties of substances or materials from the atomic to molecular scale. As a result, the physical properties of most forms of chemical substances and materials cannot be felt directly by our senses. For this reason, intermediary media such as pictures, videos, animations are very crucial in the process of chemistry learning in order to visualize the materials to be better understood by students [9]. One of the chemistry materials studied in class XI is salt hydrolysis. Salt hydrolysis material is one of the materials included in the curriculum of chemistry that students must learn and understand at senior high school (SMA/MA). The concepts discussed in salt hydrolysis material are not only limited to clearly observable concepts (concrete concepts) but also discuss abstract and complex concepts, as well as concepts involving symbolic representations [10].

Based on the interview conducted to several chemistry teachers at MAN 1 Pekanbaru, SMA IT AL Fityah Pekanbaru, and SMA IT Fadhilah Pekanbaru, it was obtained that the materials were commonly presented through power point (PPT). However, this presentation still could not make chemistry become interesting and easy to understand. For this reason, it was important to conduct research into the development of teaching materials in the form of e-modules based on information technology. Technology-based e-modules would enable the students to adapt to the current developments of information technology (IT) and could also be used in the Covid-19 pandemic period. Students who were accustomed to using IT-based materials and independent learning would indirectly develop their abilities in the field so that they could become good quality graduates who were able to compete globally and to master the development of technology [11]. In 2014, Indonesia began to introduce the Computer-Based National Examination (UNBK) which referred to a national examination system which utilized computers as test media. Students’ anxiety increased when they faced UNBK, especially in calculating subjects such as mathematics and science. This was due to that fact that schools hardly applied online learning. Thus, the schools should familiarize their students to attend online learning not only during the learning process, but also in the communication using social media and assessment systems so that teaching materials were really crucial in the learning process [12].

The e-module being developed was arranged systematically to achieve a learning indicator presented in an electronic format in which there were animations, audio, and navigation that made students more interactive with the program. The advantages of e-module in this study were that it could make the learning process more interesting, and interactive. Besides, the independent learning resources could be accessed anytime and anywhere and it could improve the quality of learning [13].

In this study, the development of e-module was conducted by using kvisoft flipbook maker application. Kvisoft Flipbook Maker is a medium for converting documents in PDF format to digital publications that are displayed like varied, innovative, and efficient digital magazines [14]. This application can help the learning process because this application not only focuses on the writings but can also include animated motions, videos, and audios that can create interactive and interesting learning media so that learning are not monotonous [15]. Furthermore, implementing a valid e-module was expected to be used for learning in the current epidemic conditions, namely the spread of Covid-19. As notified by WHO, it was suggested to stop activities that could cause crowds, including face-to-face learning that gathered students [16]. Thus, the use of digital technology enabled students and teachers to carry out the learning process even though they were in different places [17]. The form of learning used as a solution during the Covid 19 pandemic was online learning, one of which by using interactive e-module media products which was the results of this study. Through this interactive medium, teachers could present information in innovative ways and could motivate students to study harder [18].

2. Method
This study was a type of Research and Development (R&D) which utilized Plomp model consisting of three phases. The first phase was preliminary research, the second phase was development or prototype and the third phase was assessment [19]. The development of an interactive e-module on salt hydrolysis material was conducted in the chemistry education master program at the Faculty of Mathematics and Natural Sciences, Universitas Riau. A small-scale trial was conducted by using a user response questionnaire at three schools in Pekanbaru (MAN 1, SMA IT AL-Fityah, and SMA IT
Fadhilah) consisting of 3 chemistry teachers and 30 students. The e-module was developed by utilizing the Kvisoft flipbook maker application.

Data in this study were analyzed by using validation sheets, and teachers’ and students’ response questionnaires. The evaluation of media validation sheets was carried out by 6 expert lecturers, namely 3 media experts and 3 material experts. Giving meaning and decision making about the quality of e-module products were conducted by using validity criteria, as presented in Table 1 [20].

| Percentage | Criteria     |
|------------|--------------|
| 81-100     | Very valid   |
| 61-80      | Valid        |
| 41-60      | Quite valid  |
| 21-40      | Invalid      |
| <20        | Very invalid |

The analysis of the responses from chemistry teachers and students was used to find out the results of the responses of the teachers and students to the media used. This can be seen in Table 2 [21].

| Percentage | Criteria          |
|------------|-------------------|
| 80%-100%   | Attractive        |
| 60%-79%    | Quite attractive  |
| 50%-59%    | Less attractive   |
| <49%       | Not attractive    |

3. Results and Discussion

The preliminary phase aimed to conduct an investigation within the scope of the development of the e-module in salt hydrolysis material. At this phase, various analyses were carried out, such as front end analysis, student analysis, material analysis, and competency analysis. Front end analysis was performed to gather supportive information in planning further activities. The analysis was carried out through the study of various relevant literatures and interviews with chemistry teachers at three schools (MAN 1 Pekanbaru, SMA IT AL Fityah Pekanbaru, and SMA IT Fadhilah Pekanbaru). The interviews were related to teaching materials used in the learning process as well as the students' interest in the materials used for salt hydrolysis.

The results of the literature study and interviews found that the students mostly memorized the material provided by the teacher; they did not understand the explanation given by the teacher. Meanwhile, the teacher used printed books and PPT as the media in the learning process. However, the appearance of PPT did not attract the students’ attention during the learning process because this PPT did not include animations, audios, or videos. As a result, the media could not make chemistry lessons interesting and easy to understand.

Furthermore, student analysis was conducted to examine the characteristics of students in accordance with the design of the product development. Based on the interview with the teachers, it was revealed that students tried to memorize the material about salt hydrolysis more than to understand the concepts explained by the teacher. As a consequence, many students got low achievement on salt hydrolysis material (below the minimum completeness criteria). After that, material analysis was conducted to seek the material that was in accordance with the e-module being developed and the material developed was salt hydrolysis. Then, competency analysis was carried out on the syllabus of chemistry subject for senior high school (SMA/MA) set by the ministry of education...
and culture (2017). At last, the analysis of learning objectives was conducted in order to observe the objectives achieved by the students. The indicators for competency analysis were based on the suitability of competency demands of the chemistry syllabus for senior high school (SMA/MA) by the ministry of education and culture.

The second phase is the development or prototype aiming at designing the solutions for the problem found in the preliminary research phase. The prototype was an e-module on salt hydrolysis material. Before designing the prototype, tools and materials were collected in the form of text, images, audio, video, animation, flash, links and software related to the prototype. Then, the products that were designed and developed were validated. Before conducting the validation, the researchers prepared the validation sheet. Validation was carried out by the validation from the media experts and the material experts.

The third phase was the assessment phase, in which the validation of the e-module was conducted by three material validation experts and three media validation experts. The validation assessment of the material experts included aspects of content eligibility, pedagogical aspects, aspects of language assessment, and aspects of graphics. The results of the validation by the material experts are presented in Table 3.

| No | Aspects                  | Validators of Material Experts | Criteria of Validity |
|----|--------------------------|--------------------------------|----------------------|
|    |                          | I     | II    | III   | Average |                     |
| 1. | Content eligibility     | 91%   | 91%   | 84,37%| 88,79%  | Very valid          |
| 2. | Pedagogic               | 90%   | 92.5% | 80%   | 87.5%   | Very valid          |
| 3. | Language assessment     | 87.5% | 100%  | 93,75%| 93,75%  | Very valid          |
| 4. | Graphics                | 93,75%| 93,75%| 81,25%| 89,58%  | Very valid          |
|    | Average                 | 90,56%| 94,3% | 84,84%| 89,90%  |                     |
| Criteria of Validity | Very valid | Very valid | Very valid | Very valid |                     |

Based on the evaluation from the material expert validators, it was found that the salt hydrolysis e-module had fulfilled the material validity criteria with an average percentage of 89.90% and was included in the very valid category because it was located at an interval of 81-100%.

Furthermore, the evaluation of media expert validation included aspects of e-module size, cover design, and content design. The results of the media expert validation are presented in Table 4.

| No | Aspects       | Validators of Media Experts | Criteria |
|----|---------------|-----------------------------|----------|
|    |               | I     | II    | III   | Average |          |
| 1. | E-modul size | 87.5% | 87.5% | 87.5% | 87.5%   | Very valid|
| 2. | Cover design | 87.5% | 93.75%| 93.75%| 91.67%  | Very valid|
| 3. | Content design| 84,09%| 82%   | 93%   | 86,36%  | Very valid|
|    | Average       | 86,36%| 87,75%| 91,41%| 88,51%  |          |
| Criteria of Validation | Very valid | Very valid | Very valid | Very valid |          |

Based on the evaluation from the media experts, it was found that the salt hydrolysis e-module met the validity criteria of the media with an average percentage of 88.51% and was included in very valid category because it was located at an interval of 81-100%. The cover, table of contents and one view of interactive chemistry e-module on salt hydrolysis material was declared very valid both from the media experts and the material experts as seen in Figure 1.
Figure 1. Several Displays: a). Cover, b). Table of contents and c). One view of e-module on Salt Hydrolysis Material

After that, a small-scale trial to the product of e-module on salt hydrolysis was carried out to see the attractiveness of the products being developed. This small-scale trial was conducted for teachers and students through the teachers’ and students’ response questionnaires. The results of the small-scale trial conducted to three chemistry teachers and 30 students from the MAN 1, SMA IT AL Fityah, and SMA IT Fadhilah can be seen in Table 5.

Table 5. Results of questionnaires of responses of teachers and students to the salt hydrolysis e-module

| Users     | Average Percentage | Criteria of Attractiveness |
|-----------|--------------------|---------------------------|
| Teachers  | 93, 97%            | Attractive                |
| Students  | 92, 43%            | Attractive                |

Based on the results of the trial through questionnaires of teachers’ and students’ responses, it was obtained that the average percentage was respectively 93.97% and 92.43% with the criteria of attractive. These results indicated a positive response to Hydrolysis e-module which later was tested in the field during the period of the Covid-19 pandemic. The e-module produced in this study was worthy of being recommended as a source of learning material for students’ independence because it was designed systemically, interactively, and interestingly. Besides, the menus contained in the e-modules were easy to operate and could be used online for the learning process.

4. Conclusion
The interactive chemistry e-module which was developed for salt hydrolysis material was stated very valid and attractive for the students of grade XI SMA/MA. The average percentage of the validation by material and media experts was respectively 89.90% and 88.51%. Moreover, this e-module was feasible as a source of learning in online learning because based on the results of the questionnaire of teachers’ and students’ responses, it was obtained an average of 93.97% and 92.43% with the criteria of attractive.

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