

# Validity of E-module on Ion equilibrium and pH of salt solution oriented Chemo-Entrepreneurship (CEP)

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## Abstract.

The Covid-19 pandemic has affected many sectors of life, including education. Educators are required to be able to carry out online learning processes and design interesting learning instruments. One of them is attaching material in form of E-module. In this study, the E-module was designed by utilizing a digital application, namely the kvisoft flipbook maker. The design of this e-module was oriented to chemo-entrepreneurship (CEP) on ion equilibrium and the pH of salt solution materials. The aim of this study was that students possessed the skills to make a chemical-based product. The validity of the E-module was carried out with the Plomp research design consist of an initial investigation phase, a design phase, a realization/construction phase, and a validation phase. The results of the validity of E-module oriented CEP on ion equilibrium and the pH of salt solution materials revealed that the validity from the material expert was 95% with valid category and the validity from the media expert was 87% with valid category.

## 1. Introduction

The Covid-19 pandemic has affected many sectors of life, ranging from the economy to the education system [1]. In order to prevent the spread of Covid-19 in education sector, the learning process is carried out online for all levels of education. This online learning process requires teaching staffs, both teachers and lecturers, to be able to prepare teaching materials according to their needs [2]. This is not an easy thing for educators to do in a short time, especially for chemistry subjects [4]. Various obstacles experienced by educators in preparing teaching materials in this online learning process such as lack of ability to use information technology, limited internet access and unsupported infrastructure [5 6]. For this reason, chemistry educators in particular need to have adequate skills in designing and developing teaching materials.

To date, information technology is developed rapidly and the flow of globalization is increasingly unstoppable [7,8]. This is evidenced that the world has entered the era of the industrial revolution 4.0, an era in which digitalization exists in various fields of life including in the field of education. As a consequence, it is possible for educators to develop various innovations in teaching materials that are more practical and attractive [8]. One of the innovations in teaching materials is by developing an electronic module (e-module) [7,9,10,11,12].

E-module is an independent teaching material containing information presented in digital format [13] which can be accessed and used via computers, laptops, tablets and even smart phones [14]. An e-module is equipped with information in the form of videos, animations and audio [11]. Therefore, variations in the information delivery, both in verbal and non-verbal, can help students to better understand the learning material and to improve their learning outcomes [15-16].

Researchers have conducted various research on the development of e-modules as chemistry teaching materials, including an electronic module of chemistry in high school by Herawati and Muhtadi [17], an electronic module of chemical elemental chemistry by Salsabila and Nurjayadi [18], and an electronic module of biochemistry of lipid metabolism material by Seruni et al [19]. The development of e-modules as teaching materials can be executed by using several applications, one of which is the kvisoft flipbook maker

application [7,12, 20, 21, 22]. The Kvisoft flipbook maker application refers to a multimedia that can combine slides, audio, graphics, texts, sounds, videos, and animations so that this application is expected to assist teachers in teaching abstract and complex chemistry materials [12–23].

One of the abstract and complex chemical materials is ion equilibrium and the pH of the salt solution [24] which contains many facts, concepts, and procedures [25]. Based on the results of interviews with chemistry teachers at one of public schools in Pekanbaru, it was found that during the covid-19 pandemic, teachers only used an e-module in PDF format which was found on “*rumah belajar*” website and no teachers used e-modules that utilized computer technology.

In addition that this subject is considered as an abstract and complex science, chemistry is also a science that has the potential to be developed into entrepreneurship because various applications of chemistry can be found in everyday life [26]. The entrepreneurial approach in chemistry is called the chemo-entrepreneurship (CEP) approach. This approach allows students to learn the procedure of processing a material into a product that has economic value and it also fosters the students’ entrepreneurial interest [27–28]. The entrepreneurial interest needs to be increased since the students are in high school in order that they have the skills to enter the world of work [26–29]. The results of this study were expected that the e-module oriented CEP that had been validated could be applied by educators to increase students’ interest in entrepreneurship as a real skill to face the world of work.

## 2. Method

This research was research and development (R&D) with the Plomp model which consisted of an initial investigation phase, a design phase, a realization/construction phase and a validation phase [30]. The stages of e-module validation were as follows:

### 2.1. The Initial Investigation Phase

The initial investigation phase was carried out to support the needs for the development of an e-module for ion equilibrium and the pH of the salt solution material. In this phase, 4 stages of analysis were carried out, namely front end analysis, student analysis, competency analysis and material analysis.

### 2.2. Design Phase

This phase was carried out to design the draft of e-module oriented CEP and the e-module validation instrument.

### 2.3. Realization/Construction Phase

In this phase, the draft of e-module oriented CEP was constructed and the design of e-module validation instrument were carried out.

### 2.4. Validation Phase

In this phase, the validation or feasibility test of e-module oriented CEP was carried out by using a validation sheet. This validation was carried out by 4 experts, namely 2 material experts and 2 media experts.

Then, data were collected from a validation questionnaire of e-module oriented CEP that was assessed by the material experts and media experts. After that the data were analyzed by using a Likert scale scoring technique [31].

**Table 1.** Likert scale scoring criteria

Alternative Answer	Score
Strongly Agree (SA)	5
Agree (A)	4
Neutral (N)	3
Disagree (D)	2
Strongly Disagree (SD)	1

The results of e-module validation were analyzed by using the following equation [7]:

$$P = \frac{f}{n} \times 100\%$$

Note : P = Percentage  
f = Total obtained score  
n = Total score

The percentage obtained from the calculation was categorized based on the category of e-module validity [29].

**Table 2. Validity Categories**

Categories	Percentage (%)
Good/ Valid/ Feasible	81 – 100
Fairly Good/ Quite Valid/Fairly Feasible	62 – 80,9
Less Good/Less Valid/Less Feasible	43 – 61,9
Not Good	25 – 43
Very Bad (replaced)	≤ 24,9

### 3. Results and Discussions

This research produced e-module oriented CEP on the material of ion equilibrium and pH of salt solution which could be used as one of the teaching materials for teachers as well as for students as an independent teaching material outside the school. The phases of validating e-module validity carried out were as follows:

#### 3.1. Initial Investigation Phase

In this phase, an assessment of the problems faced by teachers and students in learning chemistry was carried out, especially the ion equilibrium and the pH of the salt solution material. It was found that it was necessary to develop an e-learning module. The study results of the problems found in learning chemistry on the material of ion equilibrium and the pH of salt solution were the teaching materials used by teachers and students as well as the students' entrepreneurial interest.

The analysis results of teaching materials used by teachers and students during the Covid-19 pandemic were the e-module provided on the website of "rumah belajar" in PDF form. The e-module was not combined with applications that made teaching materials interesting and fun, such as displaying various learning videos and animations. As a result, students felt bored when using the e-module on the website of "rumah belajar" during the learning process.

In addition, the teacher did not combine learning with the chemo-Entrepreneurship (CEP) approach. Whereas, many chemical materials were related to everyday life which could be used as an inspiration to be a business opportunity [32]. Based on the character of high school students, who have an age range of 16-18 years, they have maximum intellectual efficiency so that students can think logically and develop reasoning abilities in a more abstract and idealistic way [22].

The results of the competency analysis showed that the ionic equilibrium and the pH of the salt solution material were included in the basic competencies of 3.11 and 4.11 requiring students to be able to analyze the ion equilibrium in a salt solution and to determine its pH as well as to report experiments on the nature of acid-base as salt solution. Based on this competency analysis, the materials being discussed include neutralization reactions, properties of salt solutions and hydrolysis reactions in salt solutions as well as calculating the pH of salt solutions.

Based on the analysis results above, it was necessary to develop an innovation in teaching materials which was expected to answer these problems. One of the innovations was the IT-based teaching materials including various videos, learning animations, and practical simulations, which could increase students' understanding of the ion equilibrium and pH of salt solution as well as the entrepreneurial interest.

#### 3.2. Design Phase

In the design phase, the draft of e-module oriented CEP was designed on the ion equilibrium and the pH of the salt solution material as well as the e-module validation instrument. The design of the e-module oriented CEP on the material of ion equilibrium and the pH of this salt solution referred to the development guide for teaching materials issued by the Directorate of High School Development, Directorate General of Elementary and Secondary Education. The results of the initial e-module design is seen in Table 3.

**Table 3.** The Initial E-Module Design

No	Parts	Contents
1	Beginning	Cover and the title of the e-module, acknowledgement, table of contents, glossary, Basic competencies and learning indicators, a brief description of the content scope of the e-module, timeline, prerequisites, and instructions for using the chemo-entrepreneurship-oriented e-module accompanied by a concept map of the ion equilibrium and the pH of the salt solution material.
2	Contents	Chemo-entrepreneurship-oriented learning activities referring to the contextual learning with seven stages, including constructivism, asking questions, discovering, learning communities, giving examples, reflection, and real assessment.
3	End	Exercises (evaluation items), answer keys, scoring guidelines, (achievements obtained) and bibliography.

Meanwhile, the design of the validation instrument was done by collecting relevant literature on e-modules. The validation instrument consisted of material and media experts validation instruments.

### 3.3. Realization/Construction Phase

After conducting the initial design of the e-module, the realization/construction of the e-module was carried out. The e-module was constructed by Microsoft Publisher 2010 application and converted into a magazine with the Kvisoft Flip Book Maker application. The e-module consisted of 3 learning meetings. This construction was adjusted to the stages of chemo-entrepreneurship learning (CEP) while the construction of the validation instrument referred to the BSNP.

### 3.4. Validation Phase

After constructing the e-module oriented CEP on the ion equilibrium and the pH of salt solution material, the e-module was validated by material experts and media experts. The validation was carried out to 2 material experts and 2 media experts by using a validation instrument.

#### 3.4.1. Results of Material Expert Validation

Material expert validation was carried out to test the completeness of the material, the truth of the materials and the systems of the material. The validation aspects referred to the characteristics of the module, namely self-instructional aspect (the module allowed students to learn independently), self-contained (all required learning materials were contained in the module), stand alone (stand alone or the module did not depend on the material/other media), adaptive (the module followed the development of science and technology), user friendly (friendly/familiar with the user/easy to understand), chemo-entrepreneurship (CEP)/entrepreneurial aspects, pedagogic aspects and graphic aspects [27 33]. Material expert validation was carried out 2 times in order to obtain a high validity e-module. The results of material expert validation are seen in Table 4.

**Table 4.** Material Expert Validation Results

No	Aspect	Validation I	Category	Validation II	Category
1	Self-Instructional	86%	Valid	96%	Valid
2	Self-Contained	85%	Valid	95%	Valid
3	Stand Alone	85%	Valid	100%	Valid
4	Adaptive	85%	Valid	90%	Valid
5	User Friendly	78%	Quite Valid	98%	Valid
6	Chemo-Entrepreneurship	80%	Quite Valid	92,73%	Valid
7	Pedagogic	74%	Quite Valid	94%	Valid
8	Graphic	78,57%	Quite Valid	91,42%	Valid
Average		81%	Quite Valid	95%	Valid

Based on the results of material expert validation presented in Table 4, it was seen that the percentage of validation score increased from 81% in validation I to 95% in validation II. This showed that the chemo-entrepreneurship oriented e-module (CEP) was valid in the aspects of self-instructional (the module allowed students to learn independently), self-contained (all the required learning materials were contained in the module), stand alone (stand alone/module did not depend on teaching materials/other media), adaptive (module followed the development of science and technology), user friendly (friendly/familiar with the user/easy to understand), chemo-entrepreneurship aspect (CEP)/entrepreneurship, pedagogic aspects and graphic aspects. These results indicated that the material presented in the chemo-entrepreneurship-oriented e-module (CEP) was clear, complete, and in accordance with the expected Core Competencies, and Basic Competencies [34]. Then, the language used in this e-module was also in accordance with the rules of good and correct Indonesian, communicative, and easy to understand [33]. In addition, language was also crucial in the feasibility of an e-module because the language compatibility could produce effective sentences, so as to convey clear information from the author to the reader [35]. The e-module was said to be good if the sentences were simple and easy to understand, so that the information was conveyed clearly and the e-module was user friendly [26 36].

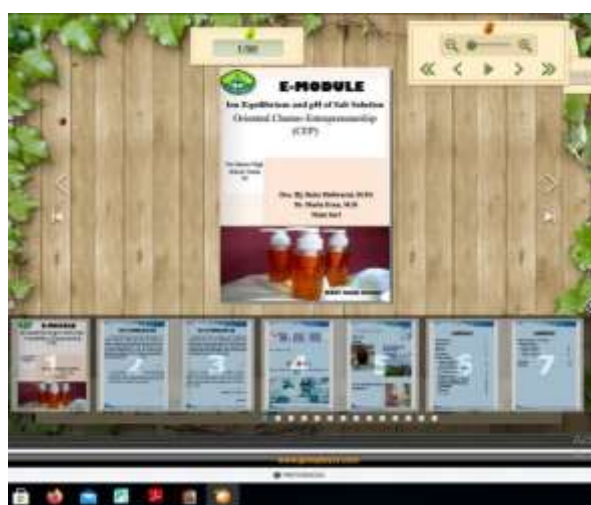
### 3.4.2. Media Expert Validation Results

The media expert validation of the e-module was carried out to test the presentation of Chemo-entrepreneurship-oriented e-module by using the Kvisoft flipbook maker application. The validation aspect of the media expert referred to the aspect of presentation criteria according to BSNP, namely the size of the e-module, the design of the cover of the e-module (cover), and the design of the content of the e-module. The results of media expert validation are seen in Table 5.

**Table 5.** Material Expert Validation Results

No	Aspects	Validation I	Category	Validation II	Category
1	E-Module size	80%	Quite Valid	90%	Valid
2	Design of E-Module Cover	52,5%	Less Valid	82,5%	Valid
3	Design of E-Module content	78%	Quite Valid	87%	Valid
Average		70%	Quite Valid	87%	Valid

Based on the results of media expert validation presented in Table 5, it was seen that the percentage increased from validation I to validation II. This showed that e-module oriented CEP fulfilled the eligibility criteria for presentation according to the BSNP. The cover of the E-module that was declared valid is displayed in the following image:



**Figure 1.** E-Module Display



In the picture, it can be seen that the E-module on Ion equilibrium and the pH of salt solution oriented CEP is easy to operate and students can repeat the material independently at any time so that it adds to the attraction. The percentage obtained in this aspect which was fairly high showed that the e-module oriented CEP on the ion equilibrium and the pH of the salt solution material supported the learning process [37] especially during this covid-19 pandemic.

#### 4. Conclusion

The validity results of the e-module oriented CEP on the ion equilibrium and the pH of the salt solution material that was developed by using the Kvisoft flipbook maker application showed that the validation from material expert was 95% with valid category and from media expert was 87% with valid category. As a result, the practicality and effectiveness of the e-module oriented CEP could be tested for the material of ion equilibrium and pH of salt solution towards the students' entrepreneurial interest.

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