

# The Validity and Practicality of the SETS-Based (Science, Environment, Technology, and Society) Interactive E-Book of Thermochemistry

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## ARTICLE INFO

### Article history:

Received February 09, 2023  
Revised February 16, 2023  
Accepted March 29, 2023  
Available online April 25, 2023

### Kata Kunci:

E-book Interaktif, Validitas, Kepraktisan, Termokimia

### Keywords:

Interactive E-book, Validity, Practicality, Thermochemistry



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## ABSTRAK

Kevalidan dan kepraktisan merupakan unsur yang penting dalam sebuah e-book karena menunjukkan ketepatan dan kelayakan bahan ajar tersebut sebelum digunakan. Tujuan dari penelitian ini adalah untuk mengetahui kevalidan dan kepraktisan Bahan Ajar berupa e-book interaktif berbasis SETS (Science, Environment, Technology, and Society) pada materi Termokimia. Kevalidan dan kepraktisan e-book perlu dikaji sebagai acuan bahwa bahan ajar yang dikembangkan layak untuk digunakan dalam pembelajaran. E-book interaktif ini dikembangkan melalui beberapa tahapan menggunakan model pengembangan DDE oleh Richey, Klein, and Nelson yang dipadukan dengan 4STMD (Four Steps Teaching Material Development). Dua tahapan validasi yang dilakukan yaitu validasi konten dan validasi media. kedua validasi tersebut berada pada kategori sangat valid. Aspek kepraktisan diperoleh dari uji coba terbatas pada Guru dan siswa di salah satu sekolah swasta di kota Makassar. Hasil uji coba pada guru berada pada kategori sangat baik dan hasil uji coba pada siswa pada kategori baik. Kevalidan dan kepraktisan e-book menunjukkan bahwa bahan ajar ini layak untuk digunakan.

## ABSTRACT

Validity and practicality are important elements in an e-book because it shows the accuracy and feasibility of the teaching material before it is used. This study aimed to determine the validity and practicality of teaching materials in interactive e-books based on SETS (Science, Environment, Technology, and Society) on thermochemical materials. The validity and practicality of the e-book are essential to study as the teaching materials developed are suitable for use in the learning process. This interactive e-book was developed through several stages using the DDE model development by Richey, Klein, and Nelson combined with 4STMD (Four Steps Teaching Material Development). Two validations were carried out, namely content validation and media validation. Both validations are in the very valid category. The practical aspect was obtained from a limited trial on teachers and students in a private school in Makassar. The test results on the teacher are in a good category, and the test results on the students are in the good category. The validity and practicality of the e-book show that this teaching material is feasible to use.

## 1. INTRODUCTION

An e-book is a printed book transferred into an electronic form displayed on computer media. When the word textbook is used, the common image in our minds is that of a physical book, but the revolution in digital technology has impacted textbook provision (Putra, 2011; Turner & Chung, 2020). E-books as teaching materials have an important role in supporting students to be able to learn independently (Fatah, 2015). This important role is shown in learning productivity, streamlining, and learning time. E-books have several advantages compared to books. Until now, most of the e-books presented are limited to text and images, so it is necessary to develop e-books that can provide videos, simulations, and animations for the

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material presented. Furthermore, interactive e-books compiled with a scientific approach effectively improve higher-order thinking (HOTS) skills (Dewi et al., 2019; Suyatna et al., 2019).

The E-book was used efficiently, and the material related to daily life (Rasmawan, 2020). The development and use of information and communication technology knowledge to improve students' understanding of chemical representations has been carried out (Kozma & Russell, 1997). This is because using technology can provide a positive learning experience in enhancing active learning through peer interaction and understanding multiple representations of molecular structures using technology (Eliyawati et al., 2020).

Interactive e-books are very suitable to be developed for chemistry because the chemistry presented includes three levels of representation, namely macroscopic, sub-microscopic, and symbolic aspects (M et al., 2022; Pietzner, 2014). The explanations in the e-book provide macroscopic, submicroscopic, and symbolic descriptions to help readers understand the concepts being studied (Rasmawan, 2020). The e-Book contains videos and images that match the contents of the content with an easy-to-read style and an easy-to-understand font (Rasmawan, 2020). The displayed pictures, videos, and animations can clarify the concepts presented (P. Munawwarah & Anwar, 2016). Information obtained verbally and visually from interactive e-books will be stored in long-term memory. In addition, exercises that provide feedback can teach students, entertain or encourage students to continue learning (Rosilawati et al., 2022). Therefore, through interactive e-books, students' understanding and interest in learning chemistry can be increased (M. Munawwarah et al., 2017; Yulianti et al., 2015).

The interactive e-book developed in this study is adapted to the current curriculum needs in Indonesia. This need is to the Ministry of National Education (2008) that the most important aspect in designing the development of teaching materials is paying attention to the demands of the curriculum. In the 2013 curriculum (currently applicable curriculum in Indonesia), MC (Main Competence) and BC (Basic Competence) have been determined by the government and applied to all schools with the same level in Indonesia. Meanwhile, BC is a competency students learn for a subject in a specific class (Kemdikbud, 2012). Therefore, the development of teaching materials must be based on the needs of students. Widayanti et al. (2019) compiled a flow of teaching materials development which states that the development of teaching materials must be given student guidelines and teaching guidelines by the plan of teaching and learning activities. Based on Ormanci & Çepni (2020) results in research and findings obtained from the teachers, it was understood that the teachers liked the interactive e-book and found it helpful.

Using the SETS approach (Science, Environment, Technology, and Society) in learning can integrate chemical concepts with everyday life. This approach can be used in the learning process in the classroom as well as in teaching material (Hidayati et al., 2020). Currently, many learning media for chemistry subjects have been developed, including challenge material, colloids, and others (Azura & Copriady, 2017; Silaban et al., 2022). The development of learning media using this approach is also carried out from elementary to high school (Hidayati et al., 2020; Purwanto et al., 2020). SETS brings knowledge about concepts you like to various aspects of everyday life. Therefore, the teaching materials can also help students improve their higher-order thinking skills (Suyatna et al., 2019).

Teaching materials in the form of interactive e-books tested for validity and practicality in this study were developed through the development research method with the DDE model initiated by designing, developing, and evaluating the resulting teaching materials. The development model combines the 4STMD (Four Steps Teaching Material Development) method. So that teaching materials are obtained by demands of the curriculum, explanations of chemistry materials, and the needs of students. The approach used is SETS (Science, Environment, Technology, and Society) in the thermochemistry developed for high school students.

This study aims to determine the validity and practicality of SETS-based interactive e-books. The validity of this e-book is reviewed from the aspect of subject accuracy, state-of-the-art, and communicative by content chemists. Media specialists validate media design and navigation or media operation. The practicality of this e-book is regarding proper function of the e-book based on the responses of teachers and students. Validity and practicality in e-book interactive are indicators for teaching material eligible for use (Febliza & Okatariani, 2020; Kartini, 2021).

## 2. METHOD

The type of research in this study is Development Research. The teaching material (E-Book) was developed using the Richey, Klein, and Nelson Developmental Research method. The development model is the DDE (Design, Development, and Evaluation) model, which is combined with the 4STMD (Four Steps Teaching Material Development) method. The general steps carried out in this study can be seen in Figure 1.

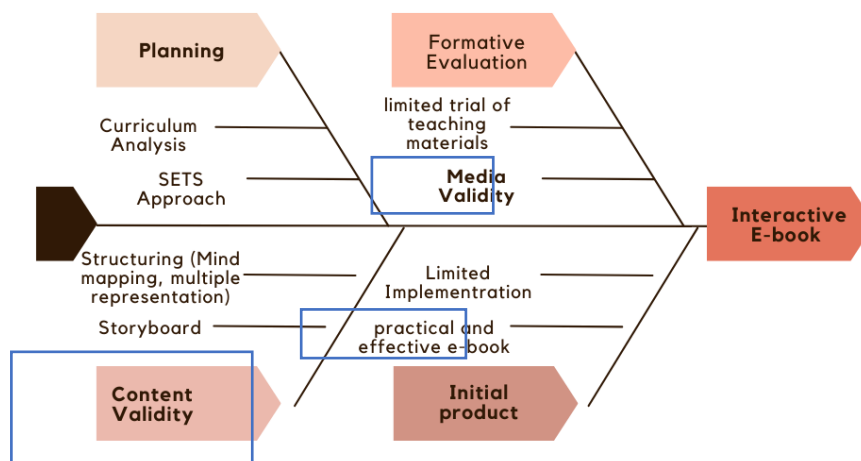


Figure 1. General stages of research

The researcher collected validation data by giving e-books to two content validators and two media validators to be given an assessment. The practicality data were obtained from the responses of three teachers and 26 students from Muhammadiyah 1 Makassar school. The instruments used in this study are open questionnaire for content validity, open questionnaire for media validity, and the questionnaire on the effectiveness and practicality of e-books for teachers and students.

The result of content and media data validity of interactive e-books are analyzed. The activities in data analysis are (Hobri, 2009): Conducting data recapitulation of the validity assessment results, including (a) aspects, (b) criteria, (c) validator assessment results; determine the average of the assessment results of all validators for each criterion with the formula; categorize the level of validity. The validity category can be seen in Table 1.

Table 1. Category of Validity

Value	Category
$3,5 \leq \bar{V} \leq 4$	VV (Very Valid)
$2,5 \leq \bar{V} < 3,5$	V (Valid)
$1,5 \leq \bar{V} < 2,5$	QV (Quite Valid)
$\bar{V} < 1,5$	I (Invalid)

SETS-based interactive e-book teaching materials are declared to have a good degree of validity if the validity level is at least valid. If the level of attainment of validity is below valid, it is necessary to make a revision based on the input the validators have given. Then the validation is done again. And so on until the SETS-based interactive e-book for high school chemistry is obtained, which has ideal validity from the size of its construct validity and content.

The practicality test of interactive e-book teaching materials was assessed through teacher and student response instruments to SETS-based interactive e-book teaching materials. After calculating student responses in each category, then determine the average of student responses. Then determine the category of responses given by students to a criterion following those listed in Table 2.

Table 2. Category of Students Respond

Value	Category
$3,5 \leq \overline{RT} \leq 4$	Very Good
$2,5 \leq \overline{RT} < 3,5$	Good
$1,5 \leq \overline{RT} < 2,5$	Bad
$\overline{RT} < 1,5$	Very Bad

The feasibility data analysis of teaching materials aims to determine the feasibility aspects of teaching materials according to the criteria of content aspects, linguistic aspects, presentation aspects,

graphic aspects, and aspects of the feasibility of teaching materials. The results of the analysis of these aspects will provide information about the suitability of the material with students, correctness in the use of grammar, communicative aspects, and the consistency of the use of terms, symbols, and symbols.

The steps taken in analyzing the data are calculating the score according to the interactive e-book. Then, presenting the correct Number of scores to match the right criteria. From the scores obtained, categorization is based on the text understanding category in Table 3.

**Table 3. Interactive E-Book Eligibility Percentage Criteria**

Percentage (%)	Eligibility Category
25 – 39	Not feasible
40 – 54	Not Good
55 – 69	Quite Good
70 – 84	Good
85 – 100	Very Good

### 3. RESULT AND DISCUSSION

#### Result

##### *Interactive E-Book Teaching Material Validation*

Data on the results of content validation and media for interactive e-book teaching materials based on SETS (Science, Environment, Technology, Society) are presented in Table 4 and Table 5.

**Table 4. Validated data on every aspect of content in the interactive e-book**

No.	Teaching Material Aspects	Value (Average)	Category
1.	Subject accuracy	3.85	VV
2.	State-of-the-art	3.83	VV
3.	Communicative	3.15	V
<b>Total Average</b>		3.61	VV

**Table 5. Validated data on every aspect of the media in interactive e-book teaching materials**

No.	Teaching Material Aspects	Value (Average)	Category
1.	Media design	3.67	VV
2.	Navigation/media operation	3.57	VV
<b>Total average</b>		3.62	VV

##### *Trial of Interactive E-Book Teaching Materials*

This interactive e-book teaching material trial was conducted on teachers and students at a private school in Makassar City. Table 6 presents the results of the trial of teaching materials by three chemistry teachers at the school. The results of the trial on students are shown in Table 7.

**Table 6. The results of the trial of the feasibility of interactive e-book teaching materials on teachers**

NO	Respondent	Eligibility percentage (%)		Eligibility Category
		Eligible	Ineligible	
1	Teacher 1	100%	0	Very Good
2	Teacher 2	100%	0	Very Good
3	Teacher 3	100%	0	Very Good
<b>Practical category</b>				<b>Very Good</b>

**Table 7. The results of practical trials of interactive e-book teaching materials on students**

No	Practical Aspects	Value (Average)
1	The cover design and content are presented attractively	3,3
2	Sentences and instructions are easy to understand	3,4
3	This interactive e-book teaching material developed is easy to use (user-friendly).	3,2
4	This interactive e-book teaching material can increase my active participation in learning	3,1
5	This interactive e-book teaching material is accessible for me to access at any time and continuously	3

No	Practical Aspects	Value (Average)
6	The features in the teaching materials give me the freedom to access more knowledge	3,2
7	E-books are exciting because they contain concepts that are complemented by animations, pictures, and videos	3,5
8	Thematic presentation of concepts (a combination of green chemistry concepts and approaches, sample questions, pictures, and videos) in e-books can make me understand science more in an integrated manner.	3,3
9	<i>This interactive e-book can improve my knowledge of information and communication technology</i>	3,2
10	It helps me to get more factual information and allows independent learning.	3,2
11	The pictures, videos, and animations that are displayed can clarify the concepts I'm learning	3,5
12	Exercises that provide feedback to readers can teach, entertain or encourage continued learning	3,3
<b>Total Average</b>		3,3
<b>Category</b>		<b>Good</b>

## Discussion

Teaching material is said to be feasible to use if the teaching material is valid and practical. Validity shows the accuracy of the material presented and the ease of running the e-book. The practicality shows that the e-book provides a positive response from users, teachers, and students.

### *The Validity of SETS-based Interactive E-Book Teaching Materials*

There are two types of validation carried out on this teaching material: content validation and media validation. Content validation aims to determine the accuracy of the material presented in the teaching materials. This process involves two validators from the chemistry department lecturer. This validation includes the correctness of indicators developed from the applicable curriculum, concepts, theories, and laws presented by the indicators developed, as well as accuracy in writing reactions and molecules of a compound. Content validators assess three main aspects of teaching material content: subject accuracy, state-of-the-art, and communication. These aspects have value with their respective criteria and become the basis for e-book improvements.

As shown in Table 5, it indicates the validation results of the content experts with the total average being in the very valid category (VV). This category shows that the developed interactive e-book has high accuracy in its material content. There are three aspects reviewed in content validation, namely Subject accuracy, state-of-art, and communicative. Especially the communicative aspect is in the valid category and needs minor improvement. As for the results of this content validation, several aspects have been improved, namely: (1) Improved concept map structure; (2) Correcting sentences in a paragraph so that they are following the truth of the concept and so that it is easier for students to understand; (3) We are adding SETS (Science, Environment, Technology, and Society) aspects to the indicators; (4) Improve the writing of compound structures in the Competency Test.

Improvements to sentence structure and indicators are deemed necessary because these are the essence of delivering material in teaching materials. The improvement made is based on an assessment of the communicative aspect. Although this category is valid, this aspect has the lowest rating. It is also based on the input provided by the content validator. Generally, the validation is in the very valid category, so this interactive e-book is feasible to use after a minor revision. In addition to the content validation process, media validation was also carried out by two media experts. This is done to know the extent of the feasibility of teaching material presented in electronic form. Several aspects that become the main review in this validation are the interactive e-book display. What aspects are the type of writing, use of background, and accuracy in positioning images according to the margins) and the function of features in teaching materials. the following are some aspects that have been improved on media validation, namely: (1) Background display on the "Skill Sharpening" feature; (2) The accuracy of the position of the margin of one of the images in the teaching materials; (3) Use of more interesting invitation sentences according to the age development of students; (4) Avoid too much text on one page.

The following shows some of the results of improvements to the interactive e-book developed based on the results of validation by media experts. Table 6 shows the category of validity level of this

interactive e-book media is included in the "Very Valid." That shows that there is no need for media design and navigation improvement.

#### *Feasibility Trial of Interactive E-Book Teaching Materials*

After the validation stage, interactive teaching materials were tested on teachers and students. The aim is to determine the practicality of teaching materials of their feasibility when tested on teachers and students on a limited scale. This trial was carried out by showing aspects of teaching materials to teachers and students. After that, the researcher sent the questionnaire link on google form as a questionnaire instrument that teachers and students could fill out as a form of assessment of the teaching material trials that had been done previously.

The trial was conducted on 26 students and three teachers at a private school in Makassar. Based on the results of data analysis from the teacher's assessment, the teacher's responses were in the "strongly agree" category. Meanwhile, based on the data analysis of the test results on students, the results of the responses were in the "Good" category. The category shows that the interactive e-book that has been developed has practicality and interactive aspects that are suitable for teaching materials for students.

In addition to filling out the Likert scale on the given instrument, teachers and students are also allowed to openly comment on interactive e-book teaching materials that have been broadcast. Some comments given by students indicate that these interactive teaching materials can help the teaching and learning process very well and effectively. In addition, these teaching materials can also encourage students to have an excellent independent learning experience. This is by the principles of interactive media or learning materials to provide a learning experience for students presented through e-books. Although there is no significant difference between students' reading accuracy through e-books and printed books, interactive e-books provide an independent learning experience for students.

Some of the comments submitted by students after the trial was carried out are: (1) *I think this event is easier to help students learn more efficiently;* (2) *I like the lesson;* (3) *Interactive e-books are very good to apply to students because they are accommodating, so it makes the learning process easier;* (4) *E-book teaching materials would be much better if they could be accessed on Android, but first, this e-book can be used in general;* (5) *It's better if the e-book can be accessed on a cellphone, not on a laptop, to make it easier to open anywhere.* The input given by both the media validator and students and teachers, the interactive e-book teaching materials developed should be able to be used on iOS and Android. This is expected to make it easier for readers to use interactive e-books anytime and anywhere without bringing a laptop.

#### **4. CONCLUSION**

The validity of SETS-based interactive E-book Chemistry teaching materials for both content and media aspects is in the "Very Valid" category. This category shows that interactive e-books have high accuracy in terms of content and use. But there are minor improvements in the communicative aspect at the content validation. E-book As for the practicality of the SETS-based interactive e-Book Chemistry teaching materials, the trials conducted on students were in the "Good" category. This category means that the interactive e-book developed has legibility that is easily understood by students. Teaching materials are tested on teachers in the "strongly agree" category. This category shows that the teacher strongly agrees if the e-book is used as student learning material. Based on the validity and practicality of interactive e-books are feasible to use.

#### **ACKNOWLEDGEMENT**

This research is supported by PNB Faculty of Mathematics and Natural Sciences. We would like to thank our Makassar State University colleagues who have provided insight and expertise that greatly assisted this research.

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