

Research Article

The Development of Mathematics for Chemistry Textbook Based on Flipbook as an Alternative Learning Resources

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Mathematics for Chemistry course is a basic course that teaches the concept of algorithms in chemistry. Students had difficulties in learning Mathematics for Chemistry because they could not understand the reference books used. So, students need math reference books that directly refer to applications in chemistry concepts. This development research aimed to produce a textbook based on flip books that can be used as alternative learning resources in Mathematics for Chemistry courses. The development model used was the 4D Thiagarajan model with four stages: define, design, develop, and disseminate. However, in this study, the development stage was only limited to the develop stage. To collect data, we used questionnaires with experts and students as respondents. The results of Mathematics for Chemistry textbooks based on flipbook development included flipbook-based textbooks packaged in EXE. The content/material validity level was 90% (very valid), the media validity (design) level was 91.25%, the practicality level was 88% (very high), and the readability level was 89% (very high). It can be concluded that this book is suitable for use as a reference in Mathematics for Chemistry courses. For further research, it is necessary to analyze the effect of this book on improving student achievement.

Keywords: mathematics, chemistry, flipbook

1. INTRODUCTION

Chemistry is a branch of natural science that has many concepts that tend to be abstract and complex, and involve formulas (mathematical calculations) and symbols. Thus, studying chemistry requires skills in conceptual, algorithmic, and graphic understanding. Often students have difficulty in solving chemistry problems related to formulas (mathematical calculations), so students need to improve their ability in algorithmic understanding. Algorithmic understanding is related to a series of mathematical rules in solving a problem [1].

One of the supporting courses that aim to improve students' algorithmic abilities is the Mathematics for Chemistry course. In this course, students learn mathematical

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concepts that support them in learning algorithmic concepts in chemistry. Some of the concepts studied in this course include numbers and variables, algebraic functions, transcendental functions, limits, differential calculus, and integral calculus. These concepts are needed by students when studying the concepts of acid-base solution pH, salt hydrolysis, reaction rate, chemical reaction equilibrium, and thermochemistry.

Based on the results of initial observations, it is known that students still have difficulties in Mathematics for Chemistry courses. This is indicated by the low average grades of students at 2017, 2018, 2019, 2020, and 2021, which are 57.78, 64.35, 64.81, 68.60, and 68.75. From the results of the questionnaire, it is also known that during face-to-face and online learning, students have learning difficulties on the topic of differential and integral calculus. These difficulties are also supported by the lack of time, lack of practice questions, difficulty in understanding the material, lack of thoroughness in working on questions, and internal factors. In addition, students also still found it difficult to understand the reference books used, so students need math reference textbooks that directly refer to applications in chemical concepts.

Textbooks are a set of materials that are systematically arranged in order to create a conducive learning atmosphere. Textbooks have an important role in efforts to improve the quality of human resources because textbooks are very important in supporting the implementation of learning. In order for the textbooks to be used effectively and efficiently in learning, the material presented must be thorough, systematic, easy to understand, interesting, innovative, able to motivate students to study independently, and in accordance with the planned competency achievements [2]. Mathematics for Chemistry textbooks should be able to facilitate students in developing process skills in learning. There are 5 (five) types of learning process skills, namely (1) problem solving, (2) reasoning and proof, (3) communicating, (4) connection, and (5) representation [3].

In order to achieve these process skills, the latest innovations in the development of textbooks are needed, one of which is using a Kvisoft Flipbook Maker. Kvisoft Flipbook Maker is a software used to develop electronic-based textbooks, so that each page looks like a printed book. By using various features in the Kvisoft Flipbook Maker, lecturers can design more interesting and innovative textbooks. The other advantages of electronic textbooks are (1) the file size is relatively small, (2) it was easy to carry anywhere, (3) it can be studied by offline or online, (4) it can be studied anywhere and anytime by using a computer, and (5) students get immediate feedback and understand the subject matter well [4–6]. Kvisoft Flipbook Maker have often been used in compiling textbooks, one of which is to support chemistry learning. The use of electronic textbooks based on Kvisoft Flipbook Maker can improve students' conceptual understanding of

stoichiometry material, where the average score of students was increased from 40.2 to 92.48 [7]. In addition, the use of electronic textbooks also can improve students' critical thinking skills on lipid metabolism material [8] and improve conceptual understanding on redox material [9]. Thus, flipbook-based Mathematics for Chemistry textbooks are expected to provide convenience, flexibility, and motivation for students to study without having to carry heavy books.

Based on these descriptions, it is necessary to develop a Mathematics for Chemistry textbook which is effectively used in online learning during the Covid-19 pandemic. With the current Covid-19 pandemic, lecturers must change the way models, strategies, and learning methods are used in order to convey material to students properly. In addition, learning resources must also be improved by making more use of technology-based learning resources so that students are more motivated to study independently. Thus, researchers want to develop and test the validity of Mathematics for Chemistry textbook to help students study independently during the Covid-19 pandemic.

2. RESEARCH METHOD

The research design used in this study was a R&D model. This development research aims to produce a flipbook-based Mathematics for Chemistry textbook. The R&D model used was the 4D Thiagarajan model with 4 (four) stages, namely (1) define, (2) design, (3) develop, and (4) disseminate. However, in this research, the development stage is only limited to the develop stage.

The product trial is carried out in the Even Semester of the 2021/2022 academic year at Universitas Billfath and UIN Antasari Banjarmasin. Research subjects are students who have taken or are currently taking Mathematics for Chemistry courses. The object of research was all of the material in the Mathematics for Chemistry course. Development procedures of Mathematics for Chemistry textbook based on flipbook using the 4D Thiagarajan model are presented in Figure 1.

Validation test is done by providing an assessment instrument in the form of a questionnaire. This test aims to determine the level of feasibility of textbooks, before field trials are carried out. The validation test was carried out by 4 (four) expert validators, of which 2 (two) lecturers as media expert validators (textbooks design) and 2 (two) lecturers as content/material expert validators. At a limited trial step, data was collected using a questionnaire given to students and lecturers as users of Mathematics for Chemistry textbooks based on flipbooks. The questionnaire aims to determine the user's response to textbooks, including the level of practicality and readability of textbooks.

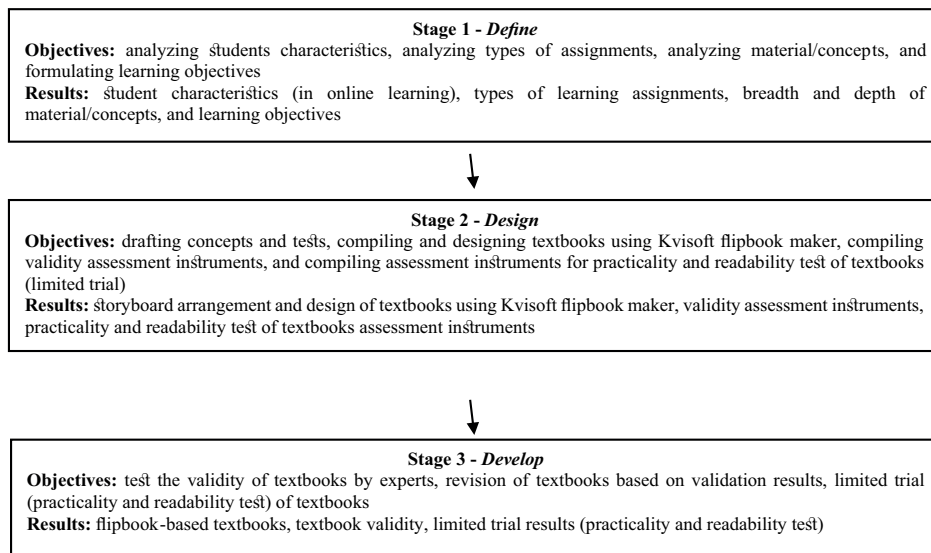


Figure 1: Development procedure of mathematics for chemistry textbook base on flipbook.

The data analysis used in this development research was descriptive quantitative analysis. Descriptive quantitative analysis aims to calculate the percentage of the feasibility of textbooks from the validation results of validators and limited trial results, as well as describe product specifications (textbooks). The formula that was used to calculate the percentage of textbook eligibility from the validation results, score of practicality and readability of textbooks from the results of the limited trial was as follows. was as follows.

$$\text{Percentage score (\%)} = \frac{\sum x}{n} \times 100\%$$

Information:

x = total score of respondents' answers for each statement item

n = maximum total score

Determination of the feasibility level of textbooks has used the following validity criteria.

TABLE 1: Validity, practicality, and readability criteria.

Percentage Score (%)	Validity Criteria	Percentage Score (%)	Practicality Criteria	Percentage Score (%)	Readability Criteria
85-100	Very Valid	81-100	Very High	81-100	Very High
70-84	Valid	61-80	High	61-80	High
55-69	Valid Enough	41-60	Enough	41-60	Enough
50-54	Less Valid	21-40	Low	21-40	Low
<50	Not Valid	0-20	Very Low	0-20	Very Low

3. RESULT AND DISCUSSION

The development of Mathematics for Chemistry textbooks based on flipbooks was carried out using the 4D Thiagarajan model. The resulting textbook is an application in the form of an EXE. The development results of Mathematics for Chemistry textbook based on flipbook have specifications, including (a) cover, (b) course description, (c) preface, (d) table of contents, (e) list of tables, (f) list of figures, (g) course overview, (h) materials (7 Chapters), and (i) bibliography.

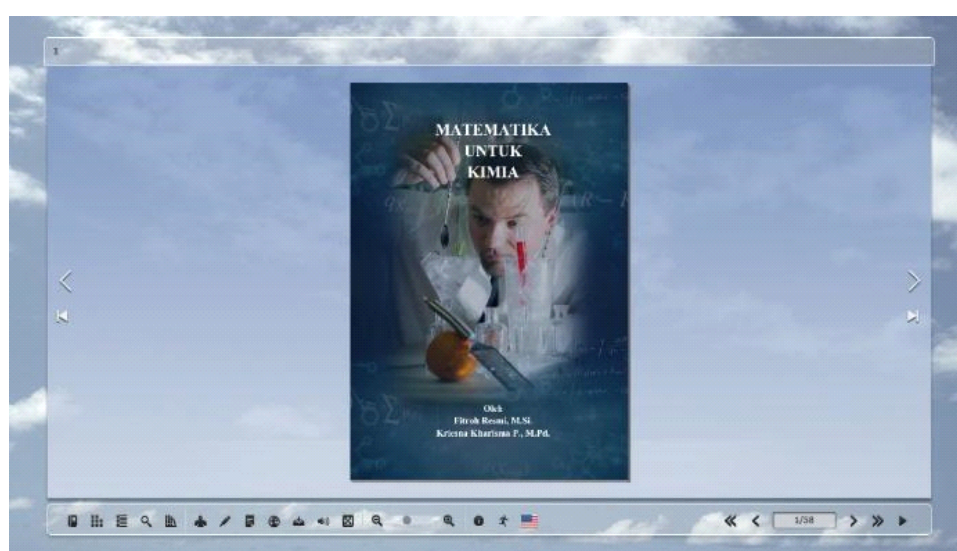


Figure 2: Cover of mathematics for chemistry textbook base on flipbook.

The validity test was carried out on the content and design of the Mathematics for Chemistry textbooks based on flipbook. The content validity results of the textbook are presented in Table 2.

Based on data in Table 2, it was known that the Mathematics for Chemistry textbook based on flipbook has an average content validity of 90% (very valid). The contents in this textbook are in accordance with the learning outcomes of the course, and the materials have been presented sequentially (100%). The assessment in the material section (Chapters 1-7) includes several aspects include (1) the breadth of the material, (2) the depth of the material, (3) the truth of the material, (4) the ease of presenting the material, (5) the suitability of the questions with the learning objectives, (6) the suitability of the questions with the material presented, (7) the ease of the questions to understand, and (8) the number of questions that given. There are two lower assessment aspects, that was Chapter 1 Operations and Real Numbers (83%) and Chapter 7 Least Squares (84%). In both chapters, improvements are still needed regarding the discussion of sample questions, editorial questions/sentences about evaluation, and the number of

TABLE 2: Content validity results of mathematics for chemistry textbook based on flipbook.

No.	The Aspects that are Valued	Score (%)	Validity Criteria
1.	The suitability of the material with the learning outcomes of the course	100	Very Valid
2.	The suitability of the material with the sub-learning outcomes of the course	100	Very Valid
3.	The suitability of the order of the material that presented	100	Very Valid
4.	Chapter 1 Operations and Real Numbers	83	Valid
5.	Chapter 2 Algebraic Functions	86	Very Valid
6.	Chapter 3 Transcendent Function	86	Very Valid
7.	Chapter 4 Descendants	86	Very Valid
8.	Chapter 5 Integral	86	Very Valid
9.	Chapter 6 Differential Equations	89	Very Valid
10.	Chapter 7 Least Square	84	Valid
	Average Score (%)	90	Very Valid

evaluation questions is still relatively small, so it needs to be added again. Besides that, both materials should be more applicable because students' motivation can be raised, if they feel that mathematics has a connection with real life [10].

TABLE 3: Design validity results of mathematics for chemistry textbook based on flipbook.

No.	The Aspects that are Valued	Score (%)	Validity Criteria
1.	Textbook based on flipbook's layout	90	Very Valid
2.	Practicality use of textbooks based on flipbook	100	Very Valid
3.	The textbook based on flipbook that was developed can be motivate students to study the materials	75	Valid
4.	The textbook based on flipbook that was developed can be used as alternative learning resources	100	Very Valid
5.	Use of language in textbook based on flipbook	90	Very Valid
6.	Writing readability in textbook based on flipbook	93	Very Valid
	Average Score (%)	91.25	Very Valid

Based on data in Table 3 it was known that the Mathematics for Chemistry textbook based on flipbook has an average design validity of 91.25% (very valid).

1. Textbook based on flipbook's layout

In this section, the assessment aspects include (a) the appearance of the cover of the textbook, (b) the display of images in the layout, (c) the clarity of the images that presented, (d) the suitability of the images with the materials, and (e) the usefulness of the images to help students understand the material. This aspect

has a validity level of 90% (very valid), meaning that the layout of this textbook based on flipbook was very good.

2. Practicality use of textbooks based on flipbook

In this section, the assessment aspects include easy use instructions and easy operating textbooks based on flipbook applications. This aspect has 100% validity (very valid), meaning that this textbook based on flipbook was very practical and does not confuse users.

(a) The textbook based on flipbook design that was developed is also quite interesting, so it is hoped that it can motivate students to study the material. The level of validity of this aspect reaches 75% (valid).

(b) The textbook based on flipbook that was developed can also be used as an alternative learning resource because the material is quite broad and in-depth, and has fulfilled the basic concepts for studying chemistry that requires algorithmic calculations. The level of validity of this aspect reaches 100% (very valid).

(c) Use of language in textbook based on flipbook

In this section, the assessment aspects include (a) the ease of language to be understood, (b) the use of standard vocabulary, (c) clarity of vocabulary, (d) unambiguous vocabulary, and (e) the ease of sentences to be understood. This aspect has 90% validity (very valid), meaning that the language used in this textbook based on flipbook was easy to understand and does not cause double perception for students.

3. Writing readability in textbook based on flipbook

In this section, the value aspects include (a) the suitability of the font size, (b) the suitability of the font selection, (c) the suitability of the spacing between lines of sentences, (d) systematic writing of titles, sub-chapters, and sub-sections. sub chapters, and (e) paragraph settings. This aspect has a validity of 93% (very valid), meaning that the material presented in the textbook based on flipbook can be read well, neatly, and systematically arranged, so that students are not confused when reading.

The limited trial was carried out on 2 small groups with a total number of respondents being 18 students. Respondents were students of the Chemistry Education Study Program who have taken or are currently taking Mathematics for Chemistry courses.

Respondents consisted of 8 students from Chemistry Education Universitas Billfath and 10 students from Tadris Chemistry UIN Antasari Banjarmasin. The limited trial carried out aims to know student's responses to practicality and readability level of Mathematics for Chemistry textbooks based on flipbooks.

TABLE 4: Practicality level result of mathematics for chemistry textbook based on flipbook.

No.	Statements	Score (%)	Practicality Criteria
1.	The use of textbook based on flipbook makes learning time more effective and efficient	94	Very High
2.	I can use this textbook based on flipbook anytime and anywhere, according to my needs	92	Very High
3.	The contents of the textbook based on flipbook as a whole are easy for me to understand	86	Very High
4.	The textbook based on flipbook help me understand the material	85	Very High
5.	The textbook based on flipbook can add insight for me	78	High
6.	The textbook based on flipbook is useful and easy for me to carry because it can be stored in a laptop and USB	75	High
7.	The textbook based on flipbook can be used over and over again	96	Very High
8.	I can study independently using textbooks based on flipbook	96	Very High
	Average Score (%)	88	Very High

TABLE 5: Readability level result of mathematics for chemistry textbook based on flipbook.

No.	Statements	Score (%)	Readability Criteria
1.	The display design of the presentation of the textbook is interesting for me to see	88	Very High
2.	The contents of the material in the textbook are equipped with illustrations, pictures, photos that match the material	83	Very High
3.	The type of font in the textbook can be read clearly by me	89	Very High
4.	The language that used in the textbook is very clear and easy for me to understand	92	Very High
5.	The description of the material and exercises in the textbook is clear and simple	92	Very High
	Average Score (%)	89	Very High

Based on data in Table 4, it was known that the Mathematics for Chemistry textbook based on flipbook has an average practicality level of 88% (very high). The highest value in the practicality aspect of this textbook was students can use the textbook based on flipbook for independent and repetitive studies, which is 90% (very high).

On the other hand, the lowest value aspect was students felt that textbooks based on flip books cannot be used more flexibly because they can only be opened using a laptop and cannot be opened via smartphone (75% validity with high criteria). This is one of the drawbacks of EXE applications of textbooks based on flipbooks. In addition, based on data in Table 5, it was known that Mathematics for Chemistry textbooks based on flipbook also have an average readability level of 89% (very high). In general, textbooks based on flipbooks fulfill the elements of good readability, where the design, image/graphic selection, font suitability, language clarity, material description clarity, and evaluation questions are very good and appropriate.

Several studies have shown that Kvisoft Flipbook Maker was good for developing textbooks, modules and other interactive learning media. For example, mathematics learning media based on Kvisoft Flipbook Maker has very valid criteria (average score 3,45 of 4,00) [11]. The e-module reaction rate based on Kvisoft Flipbook Maker has a very valid category (average score 91,16%) [12]. The water chemistry e-module based on flipbook maker has a very high category (average score 0.86 of 1.00) [13]. The digital book content for assessment and evaluation courses has a practicality level in the good category (average score 88,33%) [14].

4. CONCLUSION

The results of this development research included product specification, validity, practicality, and readability level. The Mathematics for Chemistry textbook based on flipbook was packaged in an EXE application. The developed textbooks are compiled by presenting 9 (nine) sections, including cover, course descriptions, preface, table of contents, list of tables, list of figures, course overview, materials (7 Chapters), and bibliography. Validity level of Mathematics for Chemistry textbook consisted of content validity was 90% (very valid) and media validity (design) was 91.25 (very valid). In addition, the practicality level of Mathematics for Chemistry textbook was 88% (very high), while its readability level was 89% (very high). It can be concluded that Mathematics for Chemistry textbooks based on flipbook are appropriate for use in learning. Of course, this book still needs to be tested for its effectiveness for improving student learning outcomes. Suggestions for other researchers, Kvisoft Flipbook Maker is an alternative application that can be used to develop textbooks.

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