

Development of Mind Mapping-Based Chemistry Pocketbook on Reaction Rate Material Class XI MIPA di SMAN 1 Candung

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Abstract. This study aims to obtain a valid and practical Mind Mapping-Based Chemistry Pocketbook on Reaction Rate Material for Class XI MIPA SMAN 1 Candung. This research applies Research and Development (R&D) with a 4D development model. The 4D model includes 4 phases, including: Define, Design, Develop, and Disseminate. However, the stages of research with this 4D model are only carried out until the develop stage. The subjects in this study were students of class XI MIPA SMAN 1 Candung. Data were collected using research instruments including interview guidelines, validity sheets and practicality sheets. Based on the results of data analysis, the average value of validity is 79.32% with a valid category and a practical value of 85.67% with a highly practical category.

Keywords: Chemistry, Mind Mapping, Pocketbook, Reaction rate.

1. Introduction

Teaching materials are part of the learning process (Mawarnis et al., 2023). In general, teaching materials that are often used by the teacher are printed teaching materials (Budiharti & Sutedjo, 2016). In reality, not a few teachers are less professional in developing varied printed teaching materials. In line with that, the teaching materials used by the teacher today generally do not pay attention to the needs of students, this happens because the teacher reason that they do not have the time and funds to make their own teaching materials. In addition, the ability of the teacher is still lacking, so the teacher inevitably uses commercial teaching materials that are initiated and sold by certain publishers (Tanjung, 2015). Not only that, teaching materials commonly used by the teacher are books from the Central National Education Department in the school library (Yuliani & Herlina, 2015).

The above problems are almost the same as the problems found by researchers at SMAN 1 Candung. Based on observations, it was found that textbooks with the same publisher were not evenly distributed to all students in the school, so when learning was carried out some of the students used different textbooks with the teacher and other students. E-handouts developed by the teacher are also presented with an unattractive appearance, such as lacking elements of color, images and graphics so that students are less interested in learning the material in the teaching materials used.

In addition, students are generally less interested in learning chemistry. This is because students have difficulty in understanding the learning material in the teaching materials. Where the material in the teaching materials uses a relatively long explanation so that they have difficulty in learning it. In addition, most students who get chemistry textbooks from the library leave them at school on the grounds that the book is relatively large and heavy. So that

students are not optimal for repeating their lessons at home. The limitations on teaching materials affect the interest and learning outcomes of students towards learning chemistry at school. Where the percentage of students' completeness is still lacking in the field of chemistry studies, the average student who completes chemistry in class is 23%.

The above problems can be overcome by one of them developing simple and innovative teaching materials. These teaching materials can be in the form of pocketbooks. Pocketbooks are printed materials in the form of books that contain various knowledge with a small size and can be placed in a pocket, so they can be easily carried anywhere (Mustari & Sari, 2017). According to (Salyani et al., 2018), students are generally interested in texts that do not have many descriptions and contain images, because images can help readers to imagine and improve brain performance. In addition, pocketbooks are presented in a language that is easy for students to understand, the presentation of material is brief and clear, and the appearance is attractive, so that it can build students' learning motivation and not get bored in learning (Lena et al., 2020).

The pocketbook to be developed is based on mind mapping. According to Buzan (in Setyawan & Yuliani, 2021) mind mapping is a style of note-taking that is easier to understand and remember by combining lines, colors, symbols or images. Mind mapping style notes can help learners to organize their knowledge in a structured way, so as to improve their learning outcomes (Supadmi et al., 2017). A teaching material equipped with mind mapping has various advantages. Where, Eko & Mitarlis (2021) stated that the Student Worksheet developed with the mind mapping strategy can train students' creative thinking skills in class X MIPA redox material. Not only that, Murniasih & Hariyani (2019) conducted a study whose results were that mind mapping-based pocketbooks could trigger students' interest in learning.

The learning topic that researchers use for mind mapping-based pocketbooks is eleventh grade material, namely reaction rates. The concepts contained in the reaction rate material are abstract concepts, understanding, calculations, processes, and graphs (Musya'idah & Santoso, 2016). In understanding or defining concepts such as the concept of reaction rate, factors that affect the reaction rate, reaction equation, and reaction order, an appropriate way is needed so that it can be easily understood and remembered. In order for this to be realized, one way that can be done is to develop a mind mapping-based pocketbook.

Based on the description of the background, the researchers conducted a study with the title Development of Mind Mapping-Based Chemistry Pocketbook on Reaction Rate Material Class XI MIPA SMAN 1 Candung, aiming to determine the validity and practicality of the pocketbook. This research is also expected to increase students' interest in learning chemistry.

2. Method

The research was conducted by applying the type of research, namely Research and development (R&D). The purpose of the research is to produce a product and test its effectiveness (Sugiyono, 2017). The product to be produced is a mind mapping-based chemistry pocketbook on reaction rate material for students of class XI MIPA SMAN 1 Candung. In this study, the 4D development model was applied which includes four stages, including: Define, Design, Develop and Disseminate. The research conducted by researchers only reached the develop stage. The test subjects in the research conducted were students of class XI MIPA SMAN 1 Candung.

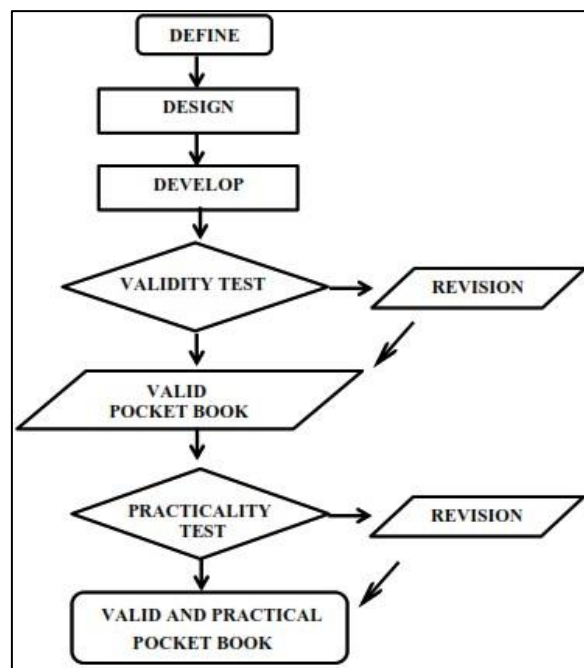


Figure 1. Research procedures

Define stage

At this stage, the conditions and problems that occur in learning in the field will be known, through front end analysis, literature analysis, and learning objectives. Front end analysis is done by interviewing chemistry the teacher grade XI, analyzing the needs of students, analyzing teaching materials, and analyzing the chemistry syllabus grade XI.

Design stage

In this second stage, the initial design of teaching materials to be developed and research instruments will be prepared. The steps in these activities are selecting teaching materials, determining the format, preparing the initial pocketbook design and preparing research instruments. The selected pocketbook template is the cover, pre-discourse, table of contents, study guide with pocketbook, competencies to be achieved, content section (mind mapping material and material explanation), evaluation, glossary, bibliography and back cover. The research instruments used include interview guidelines, validity sheets and practicality sheets.

Develop Stage

At the development stage, the final product of teaching materials will be produced, namely a pocketbook that has been revised by three validators and the product is tested on a small scale test. The product was tested on students of class XI MIPA SMAN 1 Candung by asking students to fill out a questionnaire. The validity and practicality data that has been obtained from the questionnaire, then tabulated and scoring based on Table 1. The tabulation results are sought for the percentage with the formula:

$$P = \frac{\text{score of each item}}{\text{maximum score of each item}} \times 100\% \quad (1)$$

Table 1. Scoring Categories

Categories	Score
Not valid/practical	0%-20%
Less valid/practical	21%-40%
Fairly valid/practical	41%-60%
Valid/practical	61%-80%
Highly valid/practical	81%-100%

Sumber: (Yusri & Husaini, 2017)

3. Result and Discussion

Research and Development (R&D) research was conducted at SMAN 1 Candung, Agam Regency with three stages namely define, design, and development. The research results obtained are as follows:

Results of the Define Stage

In the front end analysis there are several stages carried out, namely interviews with grade XI chemistry teachers, analysis of students' needs, analysis of teaching materials and analysis of the syllabus. The results of researcher interviews with the teacher obtained the conclusion that the teaching materials used by the teacher in learning chemistry are only textbooks and e-handouts. According to the teacher, textbooks with the same publisher that the teacher uses are not evenly distributed to all students, so that when learning is carried out some of the students use different textbooks. Limitations on the teaching materials used can affect the learning outcomes of students towards learning chemistry at school, where the value of students who can be known from the chemistry score which is below the minimum completeness criteria.

In the analysis of students' needs, researchers interviewed students of class XI MIPA and found that some students still did not fully understand chemistry material. This is because they have difficulty in understanding the subject matter in the teaching materials. The material in the teaching materials uses a relatively long explanation. And most students also admitted that they left the chemistry textbook in the desk drawer at school on the grounds that the book was relatively large and heavy. Thus, these students are not optimal for repeating their lessons at home. In addition, some of the students also said that the material sent by the educator in the Whatsapp group was sometimes also deleted on the grounds that the mobile phone memory was full.

In the analysis of teaching materials, researchers conducted observations of teaching materials used by the teacher. The results obtained are that the textbook used by the teacher has several weaknesses in the reaction rate material, namely the experiments carried out in the book require students to carry out laboratory experiments, while some of the materials contained in the guide are not available in the laboratory. For e-handouts developed by the teacher, there are several weaknesses such as no exercise questions, lack of color and image elements. In this analysis, it is known that the reaction rate material consists of 2 Basic Competencies of knowledge and 2 Basic Competencies of skills.

Literature analysis results obtained, A pocketbook is a printed device with a small size (approximately 10 cm x 14.1 cm) that contains information or learning materials and can be included in the pocket. Pocketbooks have several advantages, namely containing brief material, attractive appearance, not difficult to carry anywhere, and can focus students in learning. Pocketbooks made with interesting writing and pictures can trigger the motivation of students to explore the material in the pocketbook. In addition, students can learn the material in the pocketbook according to their needs, interests and speed (Nurhayati, 2019).

In addition to pocketbooks, researchers also conducted a literature analysis on mind mapping. According to Melania (in Faelasofi, 2016) Mind mapping is creating mind maps in a unique way so that long descriptions of words are easy to understand. Mind mapping is made by combining words, lines and colors. Alamsyah (in Imaduddin & Utomo, 2012) explains that mind mapping consists of several components, namely 1) central topic, 2) main branches that are elaborated from the center of the mind map, 3) branches from the main branches that can be elaborated in all directions, 4) words in the form of keywords, 5) images, and 6) use attractive colors.

Mind mapping-based pocketbook is a printed teaching material with a small size (approximately 10 cm x 14.1 cm) and contains learning material based on certain basic competencies equipped with mind mapping, so that the material can be presented briefly, clearly and concisely, and with an attractive, colorful and illustrated appearance. Mind mapping-based pocketbook has several components, namely: 1) cover, 2) inside cover page, 3) foreword, 4) table of contents, 5) Core Competencies, Basic Competencies, and Indicators of Competency Achievement, 6) pocketbook usage guide as instructions for the teacher and students 7) introduction section, 7) mind mapping that contains subject matter, 8) content section consisting of subject matter, 9) practice questions, 10) glossary and bibliography (Masita & Wulandari, 2018).

Mind mapping-based pocketbook has several advantages, namely: 1) independent learning resources for students in learning activities, 2) able to captivate and increase students' interest in learning, because it is presented with attractive images and colors, and 3) mind mapping in pocketbooks can help students to be able to think continuously and make it easier for them to learn (Gustina et al., 2021).

The next step is learning objective analysis. The purpose of this analysis is to find out the learning objectives of the indicators that have been made are in sync. The purpose of learning the reaction rate is that students can explore reaction rate material starting from the concept of reaction rate to its calculation. Not only that, in this material students are also required to be able to design, conduct, present experimental data and conclude experimental results appropriately. The development of teaching materials, namely mind mapping-based pocketbooks, will be synchronized with Basic Competencies and Indicators of Competency Achievement, and learning objectives to be achieved.

Results of the Design Stage

The first step taken by researchers is to choose teaching materials that are suitable for development and are based on the results of the analysis at the define stage, namely a mind mapping-based chemistry pocketbook on reaction rate material for class XI MIPA. Furthermore, researchers chose the format of the pocketbook to be developed. The selected formats are 1) cover, 2) pre-discourse, 3) table of contents, 4) Core Competencies, Basic Competencies, and Indicators of Competency Achievement 5) pocketbook usage guide as instructions for teacher and students 6) introduction section in the form of overall mind mapping, 7) mind mapping that contains subject matter and is made for each sub-chapter of material, 8) content section consisting of subject matter, sample questions, supporting information related to daily life, experiments, 9) practice questions, 10) glossary and bibliography. After selecting the format, the researcher continued to design the pocketbook according to the predetermined format with a size of 15 cm x 10 cm using Microsoft Word application.

The second stage, research instruments were designed, namely validity sheets and practicality sheets. The validity sheet designed is a validation sheet for the pocketbook validity test instrument, a validation sheet for the chemistry pocketbook, and a validation sheet for the student response questionnaire instrument for the practicality of the mind mapping-based chemistry pocketbook. Before the instrument was designed, the researcher first made the criteria. Then the instrument is designed in accordance with the criteria.

Results of the Develop Stage

In the previous stage, the pocketbook components were designed and put together into an initial pocketbook. The initial pocketbook that has been designed will be tested for validity and practicality. The following are the results of the validity and practicality of the pocketbook:

Before validating the pocketbook and the practicality test, what was done first was to validate the validity test sheet and the questionnaire sheet for students' responses to the practicality of the pocketbook using the validation sheet questionnaire for both instruments. The aspects assessed to validate the two instruments to be used include: 1) questionnaire format, 2) language, 3) questionnaire statement items. The results obtained from validating the pocketbook validation sheet are highly valid. While the questionnaire sheet for students' responses to the practicality of the pocketbook gets valid validation results.

Validation Results of Mind Mapping-Based Chemistry Pocketbook

After the validity test instrument is valid, the instrument can be given to the validator to be filled in. The results obtained can be seen in Table 2.

Table 2. Validation Results of Mind Mapping-Based Chemistry Pocketbook

No	Aspects to be validated	Score	Remarks
1	Content eligibility aspect	79,16%	Valid
2	Presentation feasibility aspect	85,42%	Highly valid
3	Aspects of language appropriateness	76,38%	Valid
4	Aspects of graphical feasibility	75%	Valid
	Total	79,32%	Valid

In Table 3, it can be seen that the overall validity test obtained a percentage of 79.32% which means valid.

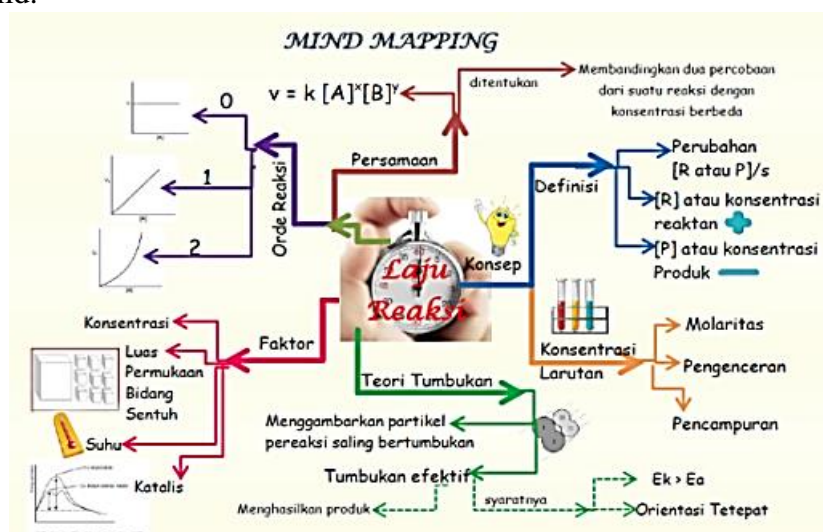


Figure 2. One of the mind mappings that has been revised after the validation stage

After the practicality test response questionnaire instrument is valid, the instrument can be used. The results obtained can be seen in Table 3.

Table 3. Results of Learner Response Questionnaire Sheet Towards Practicality of Mind Mapping-Based Chemistry Pocketbook

No	Practicality aspect	Score	Remarks
1	Ease of use	89,23%	Highly practical
2	Display	91,20%	Highly practical
3	Lesson material	78,70%	Practical
4	Language	79,86%	Practical
5	Benefits	70,83%	Practical
	Total	85,67%	Highly practical

Table 3 shows that the results of the practicality test with students on the Mind Mapping-Based Chemistry Pocketbook as a whole obtained a percentage of 85.67% which means it is highly practical.

The validation process of mind mapping-based chemistry pocketbook involves three validators, including two lecturers and one chemistry teacher. The validity test instrument was a validation sheet questionnaire with a Likert scale. Before the pocketbook validation sheet is filled in by the validator, the sheet has been validated first and gets highly valid results. Aspects of validation of mind mapping-based chemistry pocketbook include: 1) aspects of content feasibility, 2) aspects of language feasibility, 3) aspects of presentation feasibility, 4) aspects of graphic feasibility, of which the four aspects are aligned with aspects of BNSP textbook assessment (Susilo et al., 2016). Teaching materials developed can be said to be feasible and used as learning resources if all four aspects are fulfilled (Arsanti, 2018).

The content feasibility aspect obtained validity test results by validators of 79.16% which was categorized as valid. The pocketbook contains material that is in accordance with the Core Competencies, Basic Competencies and Indicators of Competency Achievement. The chemistry pocketbook is also presented with material that includes chemical concepts, facts, principles, and theories that are in accordance with the Basic Competencies and Indicators of Competency Achievement. The material in the pocketbook is also presented scientifically correct and in accordance with the material, and is related to the daily lives of students. Not only that, the experimental procedures are presented coherently and the mind mapping is presented in accordance with the material sub-chapter. In line with Prastowo's opinion (in Lestari & Winarsih, 2019), teaching materials can be defined as good if the material contained in the teaching materials refers to the Basic Competencies and is equipped with supporting material so that students' knowledge can increase.

The presentation feasibility aspect gets the results of the validity test by the validator's assessment of 85.42% which can be categorized as highly valid. The reason is that the pocketbook developed has study guidelines with pocketbooks, Core Competencies, Basic Competencies, Indicators of Competency Achievement, image sources, and evaluation questions. The presentation of learning guidelines with pocketbooks aims to make it easier for students when using pocketbooks and help the teacher in guiding students during learning (Yerimadesi et al., 2017). Learners can evaluate their own abilities on the material that has been studied in teaching materials through evaluation questions in teaching materials, so that students are able to learn on their own and will affect their learning outcomes (Yerimadesi et al., 2016). In the pocketbook there are also tables, graphs and images supporting the presentation of the material. Prastowo (in Gustinasari et al., 2017) explains that one of the

components needed in teaching materials is an image that can support and clarify the content of the material because the image can add interest and reduce the boredom of students when studying it. Not only that, pocketbooks can be used by students both individually and in groups.

The language aspect gets 76.38% validity test results from validators which can be said to be valid. This is because the pocketbook is presented with the use of language that is in sync with the development of students. In line with Rosyidah et al., (2013) explained that the level of development of students who are synchronous with the use of language in teaching materials can increase students' understanding of learning materials. In addition, the language used in the pocketbook is also adjusted to the rules of Indonesian. In teaching materials, it is very necessary to use good language so that there is no misinterpretation and difficulty in understanding the content of the material (Mailani & Wulandar, 2019). Chemical terms and symbols in pocketbooks must also be appropriate and harmonized. The terms in the pocketbook can also be understood by students through the glossary displayed at the end of the pocketbook.

The graphic feasibility aspect also received validity test results which were categorized as valid with an assessment percentage of 75%. This is because the cover and contents of the pocketbook are designed as interesting as possible and in accordance with the material and also the development of students. The writing on the contents of the pocketbook is made with 9 pt size and can be read. The appearance of teaching materials has an important position, because whether or not teaching materials are attractive is determined by their appearance. Images displayed in brightly colored pocketbooks will make pocketbooks more interesting to study than images with black and white displays (Wahyuningtyas et al., 2016). In line with the opinion of (Afriadi et al., 2013) that the images displayed on teaching materials are media that can help students in understanding the material.

The overall validity test of the pocketbook obtained an assessment result with a percentage of 79.32%. According to Riduwan (in Yusri & Husaini, 2017) this percentage indicates that the pocketbook made is categorized as valid. Thus, the eligibility requirements of the pocketbook can be said to have been fulfilled, where the material is in accordance with the truth of science and in sync with the competencies/objectives to be achieved in learning. A valid pocketbook is expected to attract attention, help students understand learning materials, remember them, and become independent learners.

After the pocketbook was validated and revised according to the validator's suggestions, the practicality test was carried out on the pocketbook. The practicality test involved 18 students. The test was carried out by filling out a response questionnaire to the pocketbook. Testing was carried out for one meeting. Previously, researchers carried out classroom learning with students using a Mind Mapping-Based Chemistry Pocketbook on reaction rate material, then filling out a response questionnaire. Aspects of the pocketbook practicality test response questionnaire refer to the modified Roliza et al., (2018) practicality test aspects: 1) ease of use, 2) appearance, 3) learning materials, 4) language, 5) benefits. Before the response questionnaire sheet was used, the sheet was validated first by the validator and found the results highly valid.

The ease of use aspect obtained results with a percentage of 89.23% which can be said to be highly practical. This is because the pocketbook can be studied alone or in groups. The pocketbook also has a mini size and is lightweight so it is not difficult to carry anywhere and learn anywhere and anytime. In line with the opinion of Premianti (2021) that mind mapping-based pocketbook are an alternative to supporting subjects because pocketbooks contain brief

material, attractive displays and are not difficult to carry anywhere, and can be used by students at any time.

The display aspect received an assessment result with a percentage of 91.20% which was categorised as highly practical. The pocketbook is presented with the appropriate size and typeface, where the contents of the pocketbook are written with a size of 9 pt and the title of the topic is given a size of 11 pt. According to Depdiknas (2008), in printed teaching materials the letters presented should be easy to read and not too small. The pocketbook is presented with a combination of attractive colors and images that are not blurry. Good teaching materials are teaching materials that can captivate the attention of students and their display design can stimulate students in learning, and are equipped with clear images with bright colors and reinforce the content of the material displayed (Faot et al., 2016). The mind mapping display in the pocketbook is also interesting and clearly presented and easy to read. In line with the opinion of (Premianti, 2021) which explains that mind mapping is made clearly and concisely so that it can help students to explore and increase learning motivation.

The aspect of learning material received an assessment with a percentage of 78.70% which was categorized as practical. This is because the learning material in the pocketbook is systematic and easy to understand. Teaching materials that combine material with structured can make students understand the contents of teaching materials. The learning material in the pocketbook is also related to the daily environment of students. Larasati et al., (2018) explain that the information presented which is associated with the daily environment can trigger curiosity and students will be challenged to learn more deeply.

The results of the language aspect are categorized as practical with a percentage of 79.86%. This is because the explanation in the pocketbook uses sentences that are easy to understand. Not only that, the terms contained in the pocketbook are also easy to understand. The terms in the pocketbook can also be understood through the glossary presented at the end of the pocketbook which contains a collection of terms related to the material. Faot et al., (2016) explained that the glossary presented aims to make it easier for students to understand the terms contained in teaching materials.

The benefit aspect gets results with a percentage of 70.83% which can be said to be practical. This is because pocketbooks can be studied either with or without a teacher and can also be studied anywhere. In line with the opinion of Ailillah et al., (2021) that pocketbooks can help students to learn independently. The results of the overall practicality test of the pocketbook are 85.67% in the student response questionnaire. According to Ridwan (in Yusri & Husaini, 2017) this percentage indicates that the pocketbook developed can be categorized as highly practical. Desyandri et al., (2019) and Mawarnis et al., (2023) explained that teaching materials are said to be practical if the materials developed are able to facilitate the teacher during learning and are also easily understood by students.

4. Conclusion

Based on the results of research and discussion, it is concluded that the Mind Mapping-Based Chemistry Pocketbook on Reaction Rate Material Class XI MIPA SMAN 1 Candung is valid and practical, so it can be used in schools. This is indicated by the validity level of the Mind Mapping-Based Chemistry Pocketbook on Reaction Rate Material Class XI MIPA SMAN 1 Candung has a percentage of 79.32% with a valid category and the level of practicality has a percentage of 85.67% with a very practical category.

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