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Development of Mind Mapping-Based E-Book in Steam for Skills Skills of Grade VI Elementary School Students

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Abstract

This research aims to develop a Mind Mapping-Based E-Book in steam learning science lesson materials by considering the characteristics, feasibility, and effectiveness of its use in elementary school classes. Tests are conducted to material experts, media experts, and students. The model used as the basis for the development of Mind Mapping-Based E-Book is ADDIE with its steps Analyze, Design, Develop, implement and evaluate. Data analysis techniques are observations and questionnaires. Based on the test results, the material expert validation results showed the material is classified as a very good category with a score of 82.62%. Media quality by linguists is classified as very good with a 90% score category. Media quality by media experts is classified as very good with a score of 85% teacher response test results fall into the category of excellent with a score of 87%. Based on the percentage of score scored it appears that Mind Mapping-based E-Books are well-category and worth using.

Keywords: *STEAM, E-book; Science Learning; Elementary School*

Introduction

The development of information and communication technology accelerates in line with globalization so that the interaction and delivery of information take place quickly. The influence of globalization can have a positive and negative impact on a country (Acesta et al., 2021). The current globalization resulted in significant changes affecting a variety of activities such as manufacturing processes, service industries, energy development, medical procedures, and various other productions (B Setiawan et al., 2017). Such changes can result in disruptions in areas such as the economy and labor market, resulting in positive things for some, and negatives for others[(Zubaidah & Malang, 2017). The workforce needed today requires a high level of skill. Skills that are expected today must be able to answer the challenges of the times, able to solve problems, innovative and have creative thinking skills, success in work and life (Pramujiono et al., 2020). One of the skills of the 21st century is creative thinking skills. Creative thinking is one of the high-level thinking skills and is the competence of a genius opinion with instinct and imagination to get new things to give interesting ideas as well as inspire unwanted ideas. The indicators of creative thinking are fluency, flexibility, and novelty. In addition, creative thinking is included in the standard of competency of primary and secondary education (Wulandari & Suparman, 2019).

Concerning 21st century skills, it takes learning that prepares learners to equip with 4C skills, namely STEM (Science, Technology, Engineering, and Mathematics) learning which later developed into STEAM (with the addition of 'Arts'). STEAM learning integrates five disciplines, namely Science/ Science, Technology, Engineering, Mathematics, and Art. Learning with the STEAM approach is contextual learning (Adriyawati et al., 2020), where students will be invited to understand the phenomena that occur close to them. STEAM stimulates students' curiosity and motivation regarding high-level thinking skills that include problem-solving, collaboration, self-learning, project-based learning, challenge-based learning, and research. STEAM's approach encourages learners to learn to explore all their abilities, in their way (Juniarso et al., 2020; Bramianto Setiawan et al., 2021). STEAM will also bring up different and unexpected works from each individual or group. With the STEAM approach, students are expected to understand the concept more easily and can apply it in daily life, and can explore the potential that exists in him who finally improves creative thinking skills. According to (Henriksen, 2014) learningnot only strengthens their learning throughoutdisiplin ilmu, melainkan melalui disiplin ilmu tersebut peserta didik juga mendapatkan kesempatan untuk mengeksplorasi dan membuat hubungan antara seni, musik, sains, dan lain-lain. On the other hand, STEAM learners feel more motivated and more effective in learning. In addition, according to (Sastrapraja et al., 2017) STEAM learning is needed by students to train their skills and talents to face the problems of the 21st century.STEAM learning is oriented on information, communication, and technology (ICT) (Iasha, 2018). One of the ICT-based media that deserves to be used is the e-book that we know as an e-book. An E-book or electronic book is a textbook that is converted into a digital format that contains digital information in the form of text, images, and even animations that are interactive and interesting so that students do not quickly get bored in learning (Marudut et al., 2020). The E-book can be especially if the learning material is a material that learns concepts that must be understood and remembered by students such as in the content of Natural Sciences (IPA) lessons (Iasha et al., 2020).

E-Book mind mapping in STEAM learning aims to improve students' creative thinking skills. Some research shows that e-book media with mind mapping gets a positive response and is more attractive to students. Some studies that review e-book with mind mapping include Development of Interactive E-Book Media Through Mind Mapping Strategy on Dynamic Electrical Subject Matter for Sma Class X (Wilujeng & Mulyaningsih, 2013)Integrated Science E-Book Oriented Mind Mapping Temperature Theme and Measurement to Foster Learning Independence participants Didik (Wenang Dwi Pramana & Dewi, 2014), Development of Mind Mapping Oriented E-Book on Hydrocarbon Subject Matter for High School Grade XI (Sridewanti & Agustini, 2014), Development of Etching (E-Book Creative Thinking) to Improve Creative Thinking Skills of Vocational Students in Ohm Law Materials (Salamiyah & Kholiq, 2020).

Students' creative thinking skills in Indonesia are still low (Haq, 2012; Permatasari &Margana, 2014; Tarlina &Afriansyah, 2016; Febriani &Ratu, 2018). Students' creative thinking skills in schools are still low due to assignments and ways of teaching teachers that have not varied (Fu'adiah, 2016; Pamungkas &Afriansyah, 2017; Muhammad, Septian, & Sofa, 2018; Pangestu &Yunianta, 2019). The problem of students' creative thinking skills also occurs in several schools in Bogor, one of them is at SDN Julang, Tanah Sareal Subdistrict. Based on discussions with grade VI teachers at SDN Julang, most of the students of grade VI at SDN Julang had difficulty in understanding lessons with materials such as Natural Sciences (IPA) (Sudrajat et al., 2021). Science subjects in elementary school (SD) is a learning introduction to environmental, social, and cultural conditions to students to learn the environment and the prospect of further development in daily life means, science is not just a collection of theories in the form of concepts and facts, but also a process of discovery (Rachamatika et al., 2021). This requires a creative thought process to learn many abstract concepts as well as a scientific process that requires experimental activities to support learning to develop students' level of understanding (Asrifah et al., 2020).

Understanding scientific concepts and scientific facts are the goals of literacy (Ajayi, 2018). Based on the data of the study results of the grade VI science subjects at SDN Julang, it shows that there are still many students who get poor learning outcomes (less than the Minimum Completion Standard).

Researchers also made observations on science learning in grade VI of SDN Julang conducted online. Based on observations, science learning is still very difficult to learn for students. This is due to several factors, including the limitation of learning resources. Learning resources are used in the form of government-issued printed books or known as theme books. Students always rely on the material in the theme book, in addition, students are less interested in learning it because one book is not separate for each subject so it confuses the learner. In addition, teachers have not used media that can attract the attention of students. Students are not serious and passive in participating in the learning activities carried out online. The learning makes students quickly feel bored. The obstacles in learning show that learning is not yet maximized, so the creative thinking skills of learners are still very low. In this case, it takes a unique learning medium, interesting and can provoke the creative thinking skills of learners. Problems in schools are also affected by the teaching materials used. Based on observations and interviews with chemistry teachers in schools, the teaching materials used so far are chemistry modules made by teachers.

In terms of materials, the module used contains a summary of 1 semester of material for chemistry with examples of questions and practice questions. The module materials used are mostly taken from existing school chemistry books then re-summarized. In terms of design, the modules used are colorless and without animation icons. According to the teacher, the module is used as a sheet of student activities in chemistry learning. The content of the module also does not yet have a component that encourages students to develop their concepts, there are not yet structured steps available to facilitate students in solving problems. students and teachers in the form of questionnaires. Based on the results of a questionnaire conducted on 30 students of SDN Julang, Tanah Sareal Subdistrict,100% of students still want teaching materials in the form of E-Book during this pandemic in science learning. students want an interesting e-book, easy to understand by students, has many pictures, and applications in everyday life. Contains complete materials so that students can study independently at school or home. Therefore, the need for the development of existing e-books is indispensable, namely more interesting modules both in terms of content, design, drawing, and conformity with the materials taught.

Methods

This research developed a mind mapping-based E-Book teaching needed development model to realize the results. The use of a model of developing Mind Mapping-based E-Books under the theory will guarantee the quality of teaching materials. Models include; models ADDIE, ASSURE, Hannafin and Peck, Gagne and Brigs, and Dick and Carey (Mummaneni et al., 2007). The model certainly has the characteristics of each that need to be understood more deeply. In this study, researchers chose ADDIE instructional model instructional process that has been commonly used both traditionally by training developers (Hendajani et al., 2019). There are five phrases, namely analysis, design, development, implementation, and evaluation that present a dynamic training and performance development device guide.

Results and Discussion

The results of the study in the form of Mind Mapping-based E-Book in steam learning science lessons. The application contains a simulation of various virtual STEAM learning objects that will appear when the application is viewed from the students' device. Mind Mapping-based E-Book in STEAM learning natural sciences (IPA) where students can carry out learning activities to learn technology, engineering, art, and mathematics. The application is stored in the form of APK files that can be deployed in various online class applications.

Figure 1. E-Book berbasis mind mapping

The instrument used to measure product quality is a questionnaire. The questionnaire consists of expert validation questionnaires and teacher questionnaires. The expert validation questionnaire was adapted from development research conducted by Almaiah, Masila, Jalil, & Man. (Almaiah et al., 2016) While the teacher response questionnaire was adapted from Cheng &Tsai. (Cheng & Tsai, 2013) Aspects of expert validation measured in this study are: 1) System Quality consisting of functionality, accessibility, interactivity, ease of use, and interface design; 2) Service Quality consists of availability, personalization, responsiveness; 3) Quality of Information consisting of the use of content and the adequacy of content; Then 4) aspects assessed in the content of Mind Mapping-Based E-Book consisting of application performance, image quality, and information delivery. While aspects of user response in this study include the use in learning consisting of satisfaction, enjoyment, entertainment, relief, motivation; and usefulness consisting of effectiveness, efficiency, and safety. The results of expert validity in the form of suggestions and inputs are analyzed using qualitative descriptive techniques while the results of the assessment of questionnaires in the form of scores from each expert are analyzed using quantitative descriptive techniques with the formula Sugiono as follows (Sugiyono, 2018).

$$P = \frac{\sum \text{Number of Questionnaire Answers}}{100\%} \times \text{N Number of Kusioner Items} \quad \text{(i)}$$

The calculation results are then identified by the standard assessment category and decisions are made for product revisions. The standard category of assessment is presented in Table I as follows:

Table 1. Decision Making for Revisions (Sugiyono, 2011)

Achievement Level	Qualification	Explanation
81-100	Worth using	Not Revised
61-80	Worth using	Not Revised
41-60	Enough	Fixed
21-40	Bad	Fixed
0-20	It's So Bad	Fixed

The participants involved are 1 (one) media expert, 1 (one) material expert, 1 (one) linguist, 5 (Teacher) grade VI teachers. The application development procedure of flipbook online using the ADDIE model is analysis, design, development, implementation, and evaluation. A detailed description of the stages in this study is as follows:

Analysis

Procedure for Developing The Stage of Definition is useful to determine and define the needs in the learning process and gather various information related to the product to be developed. In this stage, it is divided into several steps, namely: Front-end Analysis is conducted to determine the basic problems and needs in the development of Mind Mapping-Based E-Book content at SDN Julang, Tanah Sareal Subdistrict. In this special situation, of course, many students have difficulty in delivering materials because students do not directly come face to face in the correction of the e-book. Task analysis aims to identify the main tasks that will be performed by learners. Task analysis consists of the analysis of Core Competencies (KI) and Basic Competencies (KD) related to materials that will be developed through the content media of Mind Mapping-Based E-Book on science lesson content.

Design

The Design Stage is the design stage of the prototype of mind mapping-based E-Book content products. The design stage goes through several stages: Creation of Criteria Reference Test, Media selection, Format Selection, Initial Product Design. The stage of designing a data collection instrument containing items that measure media quality content E-Book Based Mind Mapping. This questionnaire was adopted from Almaiah, Masila, Jalil, &Man while the questionnaire to collect data from material experts and media system experts was adapted and developed by researchers. Media quality is seen from System Quality, Service Quality, Information Quality, and Mind Mapping E-Book Content SystemQuality.

Table 2. Grid aspects of app assessment content E-Book Based Mind Mapping

No.	Dimension	Aspects	Description
1	System Quality	Uses	App capabilities run smoothly on a variety of Android-based smartphones
		Accessibility	Application applications that are needed by students
		Interactivity	The ability of the application to facilitate various interactions with other users
		Easy to use	Application operability for users
		Interface design	The appeal of layout and interface design in mobile learning applications for its users
2	Quality of Service	availability	Ease of application to access anytime and anywhere
		Personalization	App capabilities provide learning resources related to student needs
		Responsivity	The speed at which the application is accessed
3	Quality of Information	Usability Content	Accuracy and ease of information for students to understand
		Content Adequacy	Adequacy of content following the level of educational students.
4	E-Book Application Based on Mind Mapping System Quality	performance	App capabilities can run smoothly on students' smartphone devices
		Image model quality	Model capabilities appear, follow marker movements and support interactivity with users.
		Marker Quality	Quality of markers in encoding information detected by the application
		Information delivery	Quality of the model in presenting information

In addition to the assessment instrument validator also developed a teacher response instrument. The assessed aspects of the teacher response questionnaire are user experience and media use. Media to carry out the learning of electronic media that is widely used by students, namely mobile phones. Of course, this gadget makes it easier for students to learn independently based on the teaching materials developed. Multimedia self-learning is a programmatic training format so that students can learn independently by following the audio and visual learning guidelines contained in the media. The process of developing the content of Mind Mapping-based E-Book with integrated thematic basic competency analysis of natural science (IPA) content. Then continued with the development of indicators. Each indicator is used as a basic reference for designing an e-book. The design of e-book is contextual so that they can be associated with the daily life of students.

Development

The development step is a prototype product evaluation stage conducted by expert validators. Expert validators consist of media experts, material experts, linguists. Validators are those who have expertise in every field assessed so that the evaluation results of validators can be scientifically accounted for in every aspect. The evaluation results of validators are shown in Table 3 through Table 6.

Table 3. Assessment results of experts matter in every aspect

Dimension	Aspects	Score in Every Aspect	Maximum Score	Percentage (%)
System Quality	Uses	10	12	83
	Accessibility	11	12	91,6
	interactivity	9	12	75
	Easy to use	10	12	83
	Interface design	11	12	91,6
Average System Quality Aspects				84.84
	Availability System	10	12	83
	Responsiveness	10	12	83
	Personalized	9	12	75
Average Aspects of Total Service Quality		29	36	80,4
Average service total				82.62

As can be seen in the table above material experts give a score close to the maximum on the quality dimension of the system consists of five aspects with an average aspect of 81 %. Based on the results of the trial conducted, it can run smoothly on various types of Android Phones. The content media of Mind Mapping-based E-Book is run with the contents of Mind Mapping-Based E-Book with characteristics easily carried and moved from one place to another. But of course, not all students use it efficiently because about 3% of all students used mobile phones alternately with their sister or sister. Furthermore, it doesn't require too much syntax, advertising, or settings. Aspects of interface design show. The aspect of Personalization that obtains a score almost to the maximum shows that the media can provide high student learning resources. The material is displayed in an audio-visual format. Mind Mapping-based E-Books simulate objects that students find difficult to find in a real environment. Thus, the media makes it easier for students to learn and understand the material. The responsiveness aspect measures the speed of media performance when run on mobile phones. A high score indicates that the media can run quickly when operated. Overall the media has a high system quality and service quality with a score of 83.5%.

Table 4. Language expert assessment results in every aspect

Dimension	Aspects	Score in Every Aspect	Maximum Score	Percentage(%)
Quality of Information	Matter	23	25	92
	Usability	22	25	88
	Suitability	23	25	92
	language	22	25	88
The average quality of information aspects				90

The table above shows the results of media evaluation of mind mapping-based E-Book content by material experts. Material experts assess the media with a focus on the quality of the information delivered. Mind Mapping-based E-Books have quality information if information submitted through the media is useful to students. In addition, the information is submitted under the level of education of the student. Based on the assessment of the material expert can be known that the total score given by the linguist is 90%. This score belongs to a very good category so there is no need to revise.

Table 5. Media expert assessment results in every aspect

Dimension	Aspects	Score in Every Aspect	Maximum Score	Percentage (%)
Mind Mapping Based E-Book System	Application	13	15	86
	Performance	14	15	93
	Display model quality	13	15	86
	Quality of marker feature outline information	6	15	75
The average quality of Mind Mapping Based E-Book System aspects				85

The table above presents media assessment data of Mind Mapping-based E-Book content by media experts. Augmented reality experts assess the performance of apps while running on mobile phones and the quality of mind mapping-based E-Book content in terms of resolution. The results of the expert assessment of mind mapping-based E-Book content show that the percentage of scores obtained from experts of Mind Mapping-based E-Book content systems is 85% in the Excellent category.

Table 6. Results of teacher responses to products

Dimension	Aspects	Score	Maximum Score	Percentage (%)
Experience Users	Satisfaction	18	20	90
	Entertainment	17	20	85
	Delights help	18	20	90
	motivation	19	20	95
	Support creativity, Reward	17	20	85
		17	20	85
Uses	Effectivity	17	20	85
	efficiency	16	20	80
	security	18	20	90
	Utility	18	20	90
	Learning ability	17	20	85
	Memory	16	20	85
Total		208	240	87

After the validation process, the next step is to test the practitioner's response. The response test was conducted on 5 grade VI teachers. The results of the teacher response trial are presented in the table

below which shows the data of the test results of the application usage response by the teacher. The assessed aspects are user experience and usability. The user experience assesses the experience that teachers feel when using the app. The results of the assessment showed that teachers felt happy and entertained while running mind mapping-based E-Book content. The application can also increase learning motivation. The usability aspect assesses the user's response in terms of effectiveness when used, or, for efficiency and safety. In addition, the icon is also easy to remember. The results showed that teacher test scores of 87% fall into the excellent category.

Mind Mapping-based E-Book media is very useful in the learning process during the pandemic can increase student independence (Herlandy et al., 2020) refer to the reference, the nature of learning media is to help students learn more actively. Then, students are stimulated to find the concept independently even without the presence of the teacher. Finally, augmented reality media can provide learning anytime and anywhere (flexibility).

The advantage of Mind Mapping-based E-Book compared to other learning media is that it can visualize abstract concepts into concrete concepts and seem to be understood. Many scientific objects are so small that they are difficult to see in person or even so large that they are impossible to present in the classroom. By utilizing E-Book-based media Based Mind Mapping provides solutions to the problem.

The disadvantage of Mind Mapping-based E-Book content-based content technology is that the operation still requires additional design and application. The system does not support automatic renewables. If there are improvements or additions must start from scratch. The creation of this medium must be carefully crafted in designing requires special skills.

Conclusion

Research development *Research and development* (*R&D) develop* the content of Mind Mapping-based E-Book *in elementary schools.* The development model used to develop products is ADDIE which consists of Define, Design, Develop, and Dissemination. The evaluation results showed the quality of media by material experts classified as a very good category with a score of 82.62%. Media quality by linguists is classified as very good with a 90% score category. Media quality by media experts is classified as very good with a score of 85% teacher response test results fall into the category of excellent with a score of 87%. Based on the percentage of score scored it appears that Mind Mapping-based E-Book got a good category and worth using.

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