

The Development Of Digital-Based Reference Books As An Effort Towards A Green Economy

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ABSTRACT

The purpose – of this research is to create a product in the form of a digital-based reference book in an effort toward a green economy. This digital reference book has been tested for feasibility, practicality, and effectiveness as effective student learning tools. The type of research – activity used is the research and development (RnD) method with the 4-D model (Define, Design, Develop, and Disseminate). The media expert assessment of the feasibility of presentation is 4.4 and a percentage of 88%, which means that digital books are very feasible to be used; the material expert validation for the feasibility of presentation is 4.3, and the percentage of validation results by the material expert team is 87%, which means that digital-based reference books are very feasible to be used, and the percentage of overall practicality assessment results obtained is 85% based on the results of the analysis of 30 student responses. Therefore, the conclusion is that digital-based reference books are practical to use as a source of student learning materials. The implication of this research – is that the selection of appropriate learning media significantly affects the student learning process and supports government programs in education towards a green economy.

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Introduction

As transformation and revolution in the technology sector, sustainability becomes crucial and essential because it positively balances environmental and social goals for the good of nature, society, and business (Li et al., 2016). In responding to this challenge, the green economy becomes

important to implement (Liu & Wu, 2024). A green economy is a sector that strives for sustainable growth without endangering the environment while also reducing ecological scarcity and environmental dangers (Suci Ramanda et al., n.d.). A less unpleasant, hurtful, and destructive outcome of an act or action is the environment. The disruption of the interaction between living things and their natural surroundings is linked to ecological scarcity (Rosdiana et al., 2024). When environmental risk and ecological scarcity are correlated, the balance between the natural environment and humans is disrupted, which will create abnormalities and irregularities that have implications for climate change (Istiqomah & Murwaningsih, 2025).

In order to protect and maintain the environment, every institution should focus on environmental issues (Armilah et al., 2024). In particular, educational establishments that are tasked with fostering knowledge about environmental preservation. Although eco-based schools (eco-schools) in Indonesia have implemented environmental conservation lessons and curricula, and non-eco-based schools (non-eco-schools) are advised to do the same, students' awareness and understanding of environmental sustainability remain low (H et al., 2021). The core of today's green education concept is the content of environment-based learning.

Integrating environmental concepts into the curriculum, core-oriented and applied to elementary school subjects, is a crucial step in preparing future generations who care about the environment (Okterina et al., 2025). Embedding environmental/green education in students aims to build and train students to be concerned and protect the environment from an early age, can apply environmental care attitudes in everyday life, and are agents of change for sustainability (Apsari & Agustin, 2025).

One of the researcher's efforts to be able to improve and develop a green economy, the researcher seeks to develop a learning tool in the form of learning media oriented to the effectiveness of the use of digital books that can later be used by lecturers and students with regard to efforts towards a green economy (Ramdhani et al., 2025). A digital book is an electronic book in which there is not only writing but also pictures designed to make learning more fun and easier to understand. Many studies have found that digital books can increase learning enthusiasm. The use of digital book teaching materials in learning is proven to improve student learning outcomes.

The Faculty of Teacher Training and Education is the focus of this study. Darul Ulum Islamic Center Sudirman University, Semarang Regency, includes six faculties and eight academic programs. According to an interview with one of the lecturers instructing the course, no textbooks or reference materials have been prepared as a learning aid for the students (Hudson et al., 2020). Lecturers frequently teach different courses at the start of each semester, even and odd semesters, and the solution is to give students references from other sources that are available in bookstores or libraries. This is another reason why lecturers have not created or assembled reference books (Lewis et al., 2026).

The utilization of learning media during lectures has become a necessity. The rapid utilization of information technology is also a representative choice during lectures. In addition, the use of textbooks, coursebooks, and even lecture dictates are a must for students to learn the material in each course. Therefore, lecturers also need to update student teaching materials, one of which is in the form of RPS-based student textbooks (Semester Learning Plans) in order to improve the quality of their lectures. This is in line with Kristiana, et al (2018), who stated that textbooks are able to assist students and lecturers in understanding certain course material.

Based on the background of the problems that have been stated above, it is important to develop a digital-based reference book for efforts towards a green economy (Reid et al., 2021). Researchers will create and examine products in the form of digital-based reference books that have been

compiled by researchers with the title Thematic Learning Book: Concepts, Applications, and Assessment.

Method

The type of research used in this activity is the research and development (RnD) method with the 4-D model (Define, Design, Develop, and Disseminate) used in this study.

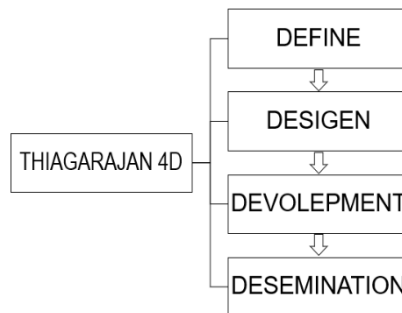


Figure 1. 4-D Research Model

Research activities are carried out to obtain information about user needs, while development activities are carried out to produce digital-based reference book products that will be tested for effectiveness and readiness levels (Khasanah et al., 2026).

This research process begins with analysing problems and needs, which is then followed by a literature review to strengthen the theoretical basis and identify similar research results. The next step is product specification, media selection, and development of validation instruments and product effectiveness tests. After the product design was developed, validation was carried out by media experts and material experts. Product trials were carried out in two stages, namely limited trials on third-semester students of FKIP Undaris, Semarang Regency, totalling 30 students. The evaluation of the results focused on the achievement of product development objectives and testing the Technology Readiness Level (TRL) to ensure the usability of the product in the field.

Data collection included validation questionnaires from the experts on media, material, and language; questionnaires on the readability of the e-book by lecturers and students; and tests to measure 21st-century life skills before and after using the Digital-Based Reference Book product. Data analysis was conducted using quantitative and qualitative approaches (Kleibert et al., 2021). Quantitative analysis was conducted to determine the percentage of feasibility of digital-based reference book products by expert validators, the percentage of product readability by lecturer and student users, and to see the improvement of 21st-century life skills through the use of digital-based reference book products (Yuan et al., 2024). Qualitative analysis was conducted to provide an interpretation of the feasibility of digital-based reference book products in thematic learning courses (Bocken et al., 2025).

Result

This research and development aim to determine the validation and feasibility of Digital-Based Reference Book products in Thematic Learning courses at FKIP Undaris, Semarang Regency, and to produce learning media that can be a reference for learning resources every year. The results of this study are based on the development procedure developed by Thiagarajan 4-D. The development procedure carried out by researchers is from four stages of development, namely Define, Design, Develop, and Disseminate.

1. Defining Stage (Define)

At this stage, the researcher has the aim of determining the problems in the use of teaching materials, which mostly still use printed media, and then determining and defining the sources of information related to the product developed, namely the Digital-Based Reference Book as an Effort Towards Green Economy (Mohammedi et al., 2025). This will make it easier to choose which teaching materials to make. Researchers conducted interviews with lecturers to obtain information on the effectiveness of using printed or digital-based textbooks (Imansyah et al., 2023). In the interview, they found that digital textbooks are more suitable for use among students and make it easier for students to access learning materials. In line with this, researchers also conducted a needs analysis by distributing questionnaires to students ("Green Empower. High Qual. Dev. CCICED Annu. Policy Rep. 2023," 2025). The indicators in the questionnaire distribution are as follows:

No.	Indicator	Field Conditions
1	Learning resources/media	1. Students use printed books and articles. 2. LCD Projector, Laptop, Handphone
2	Learning characteristics of thematic learning courses	1. Student-centered 2. Provide direct experience 3. Learning outcomes are in accordance with students' interests and needs 4. Thematic learning is based on the concept of active, innovative, creative, effective and fun learning
3	Learning process	1. Students conduct small research and publish it in the form of journal articles 2. Students create innovative learning media

Table 1. User needs analysis results user needs analysis results

The utilization of learning media in the form of printed books often makes students feel bored to learn. The following results of the analysis of student needs can be seen through the diagram below :

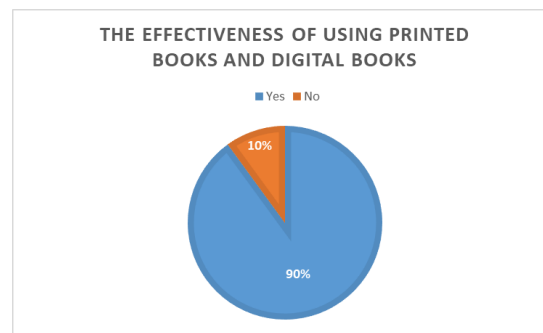


Diagram 1. Results of Student Needs Analysis

The diagram above shows that 90% of digital books are more effective than printed books, and students are more interested in reading digital books because they are considered more effective.

2. Design Stage (Design)

The design stage is the stage for drafting the overall product design and developing teaching material products that are in accordance with student needs. Teaching materials developed in the form of e-books consisting of three parts, namely introduction, content, and cover. The following is an image of the components in teaching materials in the form of digital-based reference books as follows:

a. Designing the content of reference book material

DAFTAR ISI	
Prakata.....	vi
Daftar Isi.....	vii
Bab 1 Hakikat Pembelajaran Tematik	1
A. Pendahuluan.....	1
B. Pengertian Pembelajaran Tematik.....	2
C. Prinsip Pembelajaran Tematik.....	4
D. Ciri-Ciri Pembelajaran Tematik.....	5
Bab 2 Karakteristik Pembelajaran Tematik	7
A. Pendahuluan.....	7
B. Karakteristik Pembelajaran Tematik.....	8
C. Kelebihan dan Pengaruh Dalam Pembelajaran Tematik.....	9
Bab 3 Landasan Pembelajaran Tematik	13
A. Pendahuluan.....	13
B. Landasan Pembelajaran Tematik.....	14
Bab 4 Prinsip-Prinsip Pembelajaran Tematik	19
A. Pendahuluan.....	19
B. Integrasi Mata Pelajaran.....	19
C. Keterbacaan Siswa.....	21
D. Kolaborasi dan Komunikasi.....	23
E. Pengajaran Praktis dan Kontesional.....	25
F. Penguatan Formatif dan Asesmen.....	27
G. Fleksibilitas dan Penemuan.....	28
H. Kesimpulan.....	31
Bab 5 Model Pembelajaran Tematik	32
A. Pendahuluan.....	32
B. Pengertian Model Pembelajaran Tematik.....	32
C. Konsep Model Pembelajaran Tematik.....	33
D. Implementasi Model Pembelajaran Tematik.....	36
E. Tantangan dan Solusi.....	39
F. Manfaat Jangka Panjang.....	42
G. Kesimpulan.....	44
Bab 6 Model Pembelajaran Connected	45
A. Pendahuluan.....	45
B. Definisi Model Pembelajaran Connected.....	45
C. Pembelajaran Kolaboratif Dalam Pembelajaran Connected.....	46
D. Personalisasi Model Pembelajaran Connected.....	48
E. Interkoneksi Model Pembelajaran Connected.....	50
F. Deskripsi Model Pembelajaran Connected Pada Pendidikan Global.....	53
G. Tantangan dan Kendala Model Pembelajaran Connected.....	55
H. Kesimpulan.....	57
Bab 7 Model Pembelajaran Integrated	58
A. Pendahuluan.....	58
B. Konsep Dasar Model Integrated.....	59
C. Prinsip-Prinsip Model Integrated.....	60
D. Implementasi Model Integrated.....	71
E. Kelebihan dan Kekurangan Model Integrated.....	77
Bab 8 Model Pembelajaran Webbed	80
A. Pengertian Model Pembelajaran Webbed.....	80
B. Prinsip-Prinsip Model Pembelajaran Tipe Webbed.....	83
C. Komponen-Komponen Model Pembelajaran Tipe Webbed.....	90
D. Implementasi Model Pembelajaran Tipe Webbed Dalam Konteks Pembelajaran.....	95
E. Strategi Implementasi Efektif.....	100
F. Tantangan dan Solusi.....	101
Bab 9 Elemen Dasar Pembelajaran Tematik	102
A. Perencanaan Pembelajaran Tematik.....	102
B. Penyusunan Rencana Pembelajaran.....	115
C. Implementasi Pembelajaran Tematik.....	117
D. Penanganan Penilaian Pembelajaran Tematik.....	118
Bab 10 Teknik Pembelajaran Tematik	121
A. Teknik Pembelajaran.....	121
B. Teknik Pembelajaran Tematik.....	123
C. Langkah-Langkah Pembelajaran Tematik.....	126
Bab 11 Pengelolaan Kelas Tematik	130
A. Pengelolaan Kelas Tematik.....	130
B. Indikator Kelas Tematik Efektif.....	132
Bab 12 Penutup	147

Figure 2. Content design

The design of the reference book consists of twelve (12) chapters, and the details of the book chapters are as follows: 1) Chapter I examines the Nature of Thematic Learning; 2) Chapter II Characteristics of Thematic Learning; 3) Chapter III The Foundation of Thematic Learning; 4) Chapter IV Thematic Learning Principles; 5) Chapter V Thematic Learning Model; 6) Chapter VI Connected Learning Model; 7) Chapter VII Integrated Learning Model; 8) Chapter VIII Webbed Learning Model; 9) Chapter IX Basic Elements of Thematic Learning; 10) Chapter X Thematic Learning Techniques; 11) Thematic Classroom Management; 12) Chapter XII Thematic Learning Assessment.

b. Content of digital-based reference book material



Figure 3. Content of digital-based thematic learning book material

c. Cover design of digital-based thematic learning book



Figure 4. cover design of digital-based thematic learning

3. Development Stage (Develop)

The development stage is a stage to produce development products in the form of digital-based reference books. Researchers present the material in the form of digital books and conduct validation tests of digital books in the form of objects to material experts, media experts, and linguists with validation questionnaires that have been made. The results and discussion at the development stage are described as follows:

a. Expert Validation Results

The media expert validation test aims to find out how the quality of thematic learning course textbook products is in terms of their function as learning designs. Therefore, in this study, a trial was conducted by learning design experts. In this case, the test subject is Dr. Mujiburrohmah, M.Pd.I. Based on the closed questionnaire that has been given, the results are presented in Table 2 below ;

No.	Indicator	Description	Score
Language Aspect			
1	Similarity of language with the level of students' thinking	The terms used are relevant to the science	5
2	Accuracy of sentence structure in the study	Accuracy of sentence structure in the study The language used is suitable for the cognitive level of students	5
3	Use of terminology in the study	The study is packaged in a way that is easy for students to understand	4
4	Ease of understanding the flow of material through the use of language	The flow of the study is organized according to the scientific basis	5
Aspects of Effects for Learning Strategies			
5	Ability to stimulate students' interest in learning	Media stimulates students to learn through digital-based books	5
6	Media's ability to expand student understanding	Through media, it can improve thematic learning	4
7	Media's ability to increase knowledge	Media expands students' understanding	4
8	Media competence increases students' determination in learning	Media can increase students' determination in learning	5
Digital Book Aspect			
9	Creativity and innovation in making learning media	Creativity and innovation in making media	5
10	The ease of utilization	Media is used easily	5
e-media			
11	Maintable (teaching media can be controlled easily)	Media can be operated easily	4
12	Possible advances in learning media for the advancement of technology and science	Possible advances in learning media for the advancement of technology and science	5
13	The suitability of the material in the digital book	The material is arranged in a certain order	5
Visual Display Aspects			
14	The suitability of the image on the cover with the concept	The appearance of the image used is attractive and not excessive	4
15	Appropriateness and compatibility between colors, images, shapes and sizes of letters used on the cover	Colorful appearance required	4

16	Coherence of the determination of the typeface and size determinants	The typeface must be harmonious and interesting; the size of the writing used is in harmony with the design	5
17	Design attractiveness	Attractive design	5
18	Appropriateness of image proportions	Image size is in accordance with the design and appearance	4
19	Consistency of the appearance of the images presented	The appearance of the images used is attractive and not excessive	5
20	The Easiness of material presentation to be understood by students	The material is easy to understand	5
Total score			88
Average			4,4
Percentage of score			88%

Table 2 media expert validation results

On the basis of the table above, the average assessment score from media experts for presentation feasibility is 4.4 and a percentage of 88%, which means that digital books are very feasible to use. Based on the product eligibility criteria, all components of teaching materials do not require revision (Strouse et al., 2019). The validator also provided written suggestions in the validation sheet. The summary of these suggestions includes:

- 1) Provide a different icon between the introduction icon and the material.
- 2) The depth of the material needs to be added.
- 3) Items related to learning strategies should be added with illustrations, charts, or concept maps.

The addition of illustrations and charts can facilitate student understanding, and the content becomes interactive so that it motivates students to study (Kim et al., 2026). Based on this, the researchers made revisions according to the validator's suggestions because they were supported by relevant theories.

b. Material Expert Validation Results

After the digital book has been developed, the next step is to test the resulting product. The following describes the results of the product development test, starting from the expert test with the subject of the material expert test. The results of the material expert assessment through a closed questionnaire are presented in Table 3 as follows:

No.	Indicator	Description	Score
Material Relevance Aspect			
1	Efficiency of material with CPMK	The material presented is in line with CPMK	5
2	Accuracy of the formulation of learning objectives	Learning objectives are formulated in detail	4

3	Consistency of material with the main learning objectives	The material presented is in accordance with the learning objectives	3
4	The accuracy of the material content concept from a scientific aspect	The concepts used are compatible with the concepts and definitions that apply in the field of thematic learning.	5
5	The correctness of the concept in the presentation of the material	The concept presented has novelty	4
Material Organization Aspect			
6	Material assertiveness	Delivered precisely and straightforwardly	4
7	Achievement of structured material	The material is described in a well-structured way	5
8	Material interestingness	The material must have an attraction for students	4
9	Completeness of material	The reference book must accommodate lecture material	4
10	Actuality of material	The material presented is actual and has current issues	5
11	Appropriateness of the level of challenge and abstraction of concepts	The arrangement of concept difficulties is in accordance with the level of student thinking	4
Language Aspect			
12	Use of terminologies	The terminology used is in accordance with thematic learning	4
13	Ease of understanding the flow of material through language	The language used is easily understood by students	5
14	The accuracy of the sentence structure in the study of the material	The material presented meets the proper sentence structure	5
15	Ease of understanding the flow of material through the use of language	The flow is presented easily	3
Learning Strategy and Evaluation Aspects			
16	The ability of the media to increase achievement in learning	Digital books are able to increase students' enthusiasm for learning	5
17	Media has skills by increasing knowledge media soft skills in improving knowledge	Media is able to increase student knowledge	5
18	Presentation of case studies based on actual issues	Including global issues about education	5
19	Conceptual validity	In accordance with the learning material	5
20	Arrangement of understanding case studies	Difficulties in accordance with the material presented	3
Total score			87

Average	4,3
Percentage of score	87%

Table 3 Material Expert Validation Results

The average assessment score of the material expert for the feasibility of presentation is 4.3, and the percentage of validation results by the material expert team is 87%, which means that digital-based reference books are very feasible to use with some revisions.

c. Results of Student Practicability Assessment

The assessment of the practicality test from students consists of four aspects, namely content/material aspects, presentation aspects, appearance and image aspects, and language aspects. The following presents the overall percentage of student trials presented in Table 4.

No.	Indicator	Σ score	Percentage(%)
1	Learning media can be accessed on student cell phones	84	84%
2	The presentation of material in digital-based reference book learning media is systematically arranged	82	82%
3	Language in learning media is arranged systematically	88	88%
4	The font displayed is easy to be read	84	84%
5	Interesting learning media design	92	92%
6	Learning media is easy to be used	84	84%
7	Learning media is easily accessible via cellphone	80	80%
8	Learning media can help students who are active in the learning process	85	85%
9	The existence of digital-based reference book learning media can improve learning outcomes	84	84%
Overall percentage			85%

Table 4 Results of Student Practicability Assessment

The percentage of overall practicality assessment results obtained is 85% based on the results of the analysis of 30 student responses in the presentation of Table 4 regarding the practicality or effectiveness of using digital-based reference book learning media.

d. Disseminate Stage

In the dissemination stage, the goal is to socialize digital-based reference books for efforts towards a green economy. In this study, the socialization carried out was only limited, namely by sharing and promoting the final product in the form of digital books to the academic community and students

Discussion

The findings in this preliminary study describe the needs analysis of digital-based reference books as an effort towards a green economy in the Elementary School Teacher Education (PGSD) Bachelor of Education Study Program, Faculty of Teacher Training and Education, Darul Ulum Islamic Center Sudirman University, Semarang Regency. Digital-based reference books are expected to support learning activities to be effective and efficient learning so that competencies and learning objectives can be achieved with aspects of knowledge, attitudes, and skills (Fratini et al., 2018). This digital reference book application was developed through several stages, namely with the 4-D model (Define, Design, Develop, and Disseminate).

Define stage researchers conducted a needs analysis of the development of digital-based and digital literacy-oriented reference books obtained through distributing questionnaires, observations, interviews, and document analysis (Waritsman et al., 2024). Questionnaires were used to find the needs of students and lecturers regarding the product model needed in this learning. Observation is used to analyze needs through direct observation in learning (Strouse et al., 2019). Interviews are used to find the needs of lecturers and product designs developed for learning. Document analysis is used to examine documents that support learning or archived documents from the results of learning activities (Hosseini Beghaeiraveri et al., 2025).

At the design stage, the concept design of the developed product is created (Okterina et al., 2025). This stage begins with the formulation of learning objectives based on core competencies and basic competencies, which are then outlined in the form of a concept map (Teng et al., 2024). This concept map describes the subject matter presented in the digital-based reference book. Then design the concept of the product. The digital-based thematic learning reference book is designed with an equipped design (Ramdhani et al., 2025).

The development stage is obtained by a digital-based reference book that has been compiled and consists of three parts, which are: 1) the beginning includes a cover page, preface, table of contents, list of images, core competencies and basic competencies, indicators of achievement of competencies and learning objectives, and concept maps; 2) the content includes an introduction, material presented from aspects of learning material in thematic learning courses; 3) the final part includes a summary and exercise tests. The digital-based reference book that has been completed is then validated to determine the feasibility level of the book developed.

Validation of digital-based reference books was carried out by two expert validators and one user validator. The aspects of product feasibility assessment consist of 3 aspects, namely construct aspects, content aspects, and language aspects. The construct aspect aims to provide an assessment of the content components in the textbook and the quality of the presentation of the material (Apsari & Agustin, 2025). The content aspect aims to provide an assessment in terms of renewal and needs. The language aspect aims to provide an assessment of the use of language and the level of readability of digital-based physics reference books. The average assessment score from media experts for presentation feasibility is 4.4, and the percentage is 88%, which means that digital books are very feasible to use. The average assessment score of the material expert for the feasibility of presentation is 4.3, and the percentage of validation results by the material expert team is 87%, which means that digital-based reference books are very feasible to use with some revisions. The percentage of overall practicality assessment results obtained is 85% based on the results of the analysis of 30 student responses in the presentation of Table 4 regarding the practicality or effectiveness of using digital-based reference book learning media.

At the dissemination stage, the aim is that digital-based reference book development products, as an effort towards the green economy, can be useful for the academic community, students, and the public (Kim et al., 2026). In order to save the environment, it is intended that digital book offerings will decrease the usage of paper books. The result of this research and development is digital reference books that are compatible with Android-powered smartphones (Rohmy & Nihayaty, 2023). With its presentation of multimodal content, including text, photos, audio, and video, this digital book focuses on critical thinking abilities regarding the material form of objects. Additionally, it has Wordwall activities to make learning more engaging. According to the idea (H et al., 2021).

The development of digital books on the material form of this object is one of the efforts that can be made to produce learning media oriented to critical thinking skills (Hudson et al., 2020). According to media is a strategic instrument that has a role in determining the success of a learning process in the world of education. With digital book teaching materials, teachers will easily convey learning to students (Lewis et al., 2026). Students will also find it easier to understand the learning delivered by the teacher. This is in line with the opinion of which states that with the use of digital books, the learning environment becomes more effective and enjoyable. According to, students are more inclined to like books that contain moving and colorful animations, so that it can make students more motivated to learn (Suci Ramanda et al., n.d.).

The conclusion of the research is that the development of digital-based reference books as an effort towards a green economy is feasible and valid as a digital-based reference book in accordance with the steps of development research (Calhau et al., 2024). Analyzing the material and media expert validation questionnaires as well as the student response questionnaires yielded the study's findings. Based on the results of this analysis, it can be stated that the development of digital-based reference books as an effort towards a green economy can be categorized into valid and feasible teaching materials in accordance with the stages of research and development procedures (Research and Development).

Conclusion

Based on the results of the research and discussion, it can be concluded as follows: Digital-based reference books as an effort towards a green economy were developed using the Research and Development (R&D) method with the 4-D model (Define, Design, Develop, and Disseminate). Material expert validation for presentation feasibility was 4.3, and the percentage of validation results by the material expert team was 87%, which indicates that digital-based reference books are very feasible to use. The overall practicality assessment result obtained was 85%. Based on the results of the analysis of 30 student responses regarding the practicality or effectiveness of using digital-based reference book learning media, the quality of digital-based reference book development on the presentation feasibility assessment by media experts is 4.4 and a percentage of 88%, which means that digital books are very feasible to use.

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