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Development of interactive e-books in tissue culture learning for class xi science

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ABSTRACT

The learning media used in schools is in the form of books. In addition, the media used by schools contains material that is not yet specific and not yet interactive, so it is necessary to develop media that suits needs, such as interactive e-books. This study aims to produce an interactive e-book learning media on the tissue culture sub-material on the structure and function of tissues in plants that are valid. This development research uses the ADDIE development model whose implementation reaches the third stage, namely Analysis, Design, and Development. This interactive e-book was created using the Flip PDF Corporate Edition application. The sampling technique used in this research is random sampling. The sample used in the study was 45 students of class XI IPA SMA. The data collection instruments used were validation sheets and validated student response questionnaires. Data collection was carried out using student and teacher response questionnaires. Product validation uses validation sheets carried out by material, media, and learning experts. Data were analyzed using the analytical technique of the scale method with a modified Likert scale. The average product validation test results obtained a percentage of 91.62% with a very valid interpretation. The developed learning media also received good responses from students in three schools with an average percentage of 79.75% with good interpretation. So it can be concluded that the developed interactive e-book learning media is very valid for use in learning. Further research is needed to develop and test the effectiveness of media in the learning process.

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INTRODUCTION

The education system in Indonesia has undergone several curriculum changes. The current development of the education system in Indonesia requires students to adapt to the conditions they will face in the future such as globalization, environmental problems, progress in information, and the convergence of science and technology. One of the many things developed by the government in the field of education in Indonesia is the 2013 curriculum (Hasan et al., 2018). Recently education has undergone significant changes along with the advent of digital technology such as computers/laptops, cell phones, internet, e-learning, and e-books. (Tania & Fadiawati, 2015). To keep up with changes in the education system, we need innovation in both learning media and learning resources that will be used in class. This innovation is by using information technology in education which can bring up a variety of methods in providing information and the effect is very important in increasing student achievement.

Biology material includes various abstract concepts and event processes, making it a subject that reduces students' learning motivation. Furthermore, students' perceptions of biology texts tend to reflect texts that require memorization, especially in the context of their processes (Maryanti & Kurniawan, 2018). The use of media in teaching and learning activities can increase the desire and interest of students but it can also make students more motivated to learn and also the availability of media allows students to participate actively in learning activities (Hendratno et al., 2022; Wulandari et al., 2019). Media consists of two important elements, namely hardware and software. Software is information or teaching material itself that will be conveyed to students, while hardware is a means or equipment used to present messages/teaching materials. The characteristics of interactive learning media are that students not only pay attention to media or objects but are also required to interact while participating in learning. There are three types of interactions, namely: (1) that shows students interacting with a program, for example, students are asked to fill in the blanks in programmed learning material, (2) students interact with machines, such as machine learning, simulators, language laboratories, computers, or a combination thereof. the form of interactive videos, (3) organize interactions between students regularly but not programmed (Putri et al., 2020).

E-books are a form of innovation in teaching materials as well as learning resources(Tania & Fadiawati, 2015). The e-book appears as an interactive way to increase this achievement. In addition, e-books are easy to obtain and access, making it easier for teachers and students to study anytime and anywhere(Mohammed & Rahman, 2015). Access to e-books in their use is closed which can only be read with special tools and programs. Each file can only be read with a specially prepared device (e-book reader). In addition, some e-books can be read by various digital devices, namely e-books available on the internet(E. Suryani & Khoiriyah, 2018). Interactive e-books are a form of digital book that allows readers to interact. Furthermore, an interactive e-book is a type of e-book that contains interactive elements to increase the effectiveness of learning for students. The interactive components in this e-book include instructions, moving objects, clicking, audiovisual elements, and game elements. The creation of this e-book involves a variety of media such as audio, video, text, or images, and has properties that allow interaction (SC Chang et al., 2016; WH Chang et al., 2018; Gui, 2019; Setiyanigrum et al., 2022)

Electronic books (e-books) are designed using flip PDF corporate edition software. The features provided are very diverse, such as a combination of text, images, audio, and video, which makes the creation of electronic books more interactive and provides interesting results (Purbalingga, 2020). The corporate edition PDF file software is an application used to convert PDFs into digital flipping pages that allow us to create interactive learning content. Flip PDF corporate edition is an interactive media that can easily add various types of animated media to a flipbook. Only by dragging, dropping, or clicking, we can insert YouTube videos, hyperlinks, animated text, images, audio and flash into the flipbook. Everyone can produce amazing flip books easily (Himma, 2019).

Based on the results of observations and initial interview which was carried out in November 2020 in three schools, information was obtained that tissue culture material is one of the materials contained in Biology lessons. The media used in schools is in the form of Electronic School Books (BSE) from the government which are printed in book form. The media used by schools contains material that is not yet specific and not yet interactive, so it is necessary to develop media according to needs. During the learning process, students find it difficult to follow and understand the subject matter so learning activities in class are limited to listening and taking notes students also tend to be less interested in participating in learning because they only rely on printed books and explanations from the teacher. This is supported by research conducted byMellisa and Imania (2022) in the results of interviews that have been conducted with teachers stated that in the learning process, students only use printed book media so that students forget media other than books such as e-modules as a reference to support their knowledge and insights.

In addition, schools also do not yet use interactive e-books in the learning process in class. In this case, the researcher develops media in the form of an interactive e-book which will not only contain explanations but also pictures and videos that can support the achievement of learning objectives. The development of this media also aims to help schools with the problem of limited teaching materials on tissue culture material in teaching biology at school. According toRafli & Adri (2019) the use of learning media that is still not optimal and some learning materials that still do not have appropriate media for learning can affect learning objectives. Therefore, with appropriate and appropriate learning media, students can be more focused on an active, creative, and independent learning process.

Tissue culture is a technique of plant propagation by multiplying plant microtissue in vitro to become perfect plants in unlimited quantities. (Mellisa & Yanda, 2019) Underlying tissue culture is cell totipotency, namely that every plant organ is capable of growing into a perfect plant when placed in an appropriate environment (Mellisa & Yanda, 2019). Plant tissue culture is a technique for growing cells, tissues, or slices of plant organs in the laboratory on an artificial medium containing aseptic (sterile) nutrients to become a whole plant. Sterile conditions are an absolute requirement for the successful implementation of tissue culture(Dwiyani, 2015). Tissue culture is based on the theory of cell totipotency which states that each plant cell can regenerate to form a complete plant. (Dwiyani, 2015). The explant is the term for the initial plant material used in micropropagation. Explants can be cells (cell culture), protoplasts (protopals culture), epidermis, pith (tissue culture), apical or lateral meristems (meristem culture), apical and lateral buds (shoot culture), and slices of stems, leaves, or roots (cultivation). organ). Later explants will be grown in growing media that has been given nutrition. Explants grown in vitro on artificial media require nutrients for morphogenesis and growth. Based on the background above, the researchers developed learning media in the form of interactive e-books in learning culture nets for class XI IPA SMA/MA.

METHODS

Research Design

This study uses the ADDIE model developed by Molenda (2015) which consists of five stages, namely analyze (analysis), design (design), develop (development), implement (implementation), and evaluate (testing). The ADDIE model was chosen because it corresponds to the problems underlying this research, there is curriculum analysis, needs analysis, and task analysis, and looks at student characteristics and existing conditions. In addition, the ADDIE model was chosen because this model is a coherent, simple, systematic design and there are validation and trial stages to make product development more perfect. The ADDIE model also provides opportunities for continuous evaluation and revision in each phase that is passed, so that the resulting product becomes a product that is suitable for use.

Population and Samples

The population of this study was 3 high schools in Pekanbaru, namely SMA N 14 Pekanbaru, MAN 2 Model Pekanbaru, and SMA N 5 Pekanbaru. The sample of this study was students of class XI IPA SMA/MA Pekanbaru. Each school appointed 15 students as research samples so the total sample used in this study was 45 students (Table 1). These schools were selected by researchers as research locations based on several considerations, namely schools with A accreditation and have implemented the 2013 curriculum. This research was conducted during the Covid-19 pandemic in June-September 2021.

Table 1
Research Samples

No	School	Number Of Samples
1	SMAN 14 Pekanbaru	15 Students
2	MAN 2 Model Pekanbaru	15 Students
3	SMAN 5 Pekanbaru	15 Students
	Total	45 Students

Instruments

The instruments used to collect data were product validation sheets and student response questionnaires. Validation sheets were given to validators, namely media expert validators, material experts, and learning experts. This validation sheet aims to determine the validity of the product in the

form of an interactive e-book that has been developed. Assessment aspects and media validation sheet items can be seen in Table 2 and Table 3.

Table 2
Expert Validation Sheet Grids (Media, Materials, and Learning)

No	Aspect	Indicators	Number Of Statements
Media Validation Sheet Grid			
1	Appearance	Cover Design Suitability	3
		Interactive E-Book Design	4
		Text Readability	2
		Simple And Alluring	2
		Clarity Of Video/Image Display	3
		Completeness Of Multimedia Components	2
		Interactive	3
2	Programming	Maintainable	3
		Usability	5
		Compatibility	2
		Reusable	3
Material Validation Sheet Grid			
1	Programming	Frown	4
		Study Material	4
Learning Validation Sheet Grid			
1	Display Order	E-Book Cover View	1
		Video View	1
		Image Display	1
		Clarity Of Learning Objectives	1
		Conformity Of Learning Objectives With Kd	1
		The Suitability Of The Material With The Learning Objectives	1
		Systematic, Sequential, And Clear Logical Flow	1
2	Language	Language	1
3	Ease Of Reading	Ease Of Reading	1
		Easy To Understand	1

In addition to the validation sheets of media experts, material experts, and learning experts, student response questionnaires were also used in this study. This questionnaire is used to determine students' responses to the interactive e-book learning media developed. Filling in the student response questionnaire was carried out by 15 students in each school who had studied tissue culture material via the Google form link. The questionnaire sheet used consists of several aspects which can be seen in table 3.

Table 3
Student Response Questionnaire Grid

No	Aspect	Indicators	Number Of Statements
1	Appearance	Cover Design	4
		Text Legality	4
		Interactive E-Book Design	3
		Simple And Alluring	2
		Clarity Of Video/Image Display	4
2	Language	Language	3
3	Theory	Presentation Materials	3
		Study Materials	3
4	Benefits	Motivation	6

Procedure

The ADDIE model is the main component of the systems approach to developing learning and developing procedures in learning (Mellisa et al., 2023; Suryani et al., 2018). The ADDIE (Analysis to Development) steps applied in this research are presented in Figure 1. The analysis phase consists of curriculum analysis, needs analysis, and student analysis. Then the design stage consists of interactive e-book planning, design, and creation of interactive e-books. The development stage consists of interactive e-book trials and validation by media experts, material experts, learning experts, and also Biology teachers. The valid interactive e-book learning media was tested on students who had studied Network Culture material.

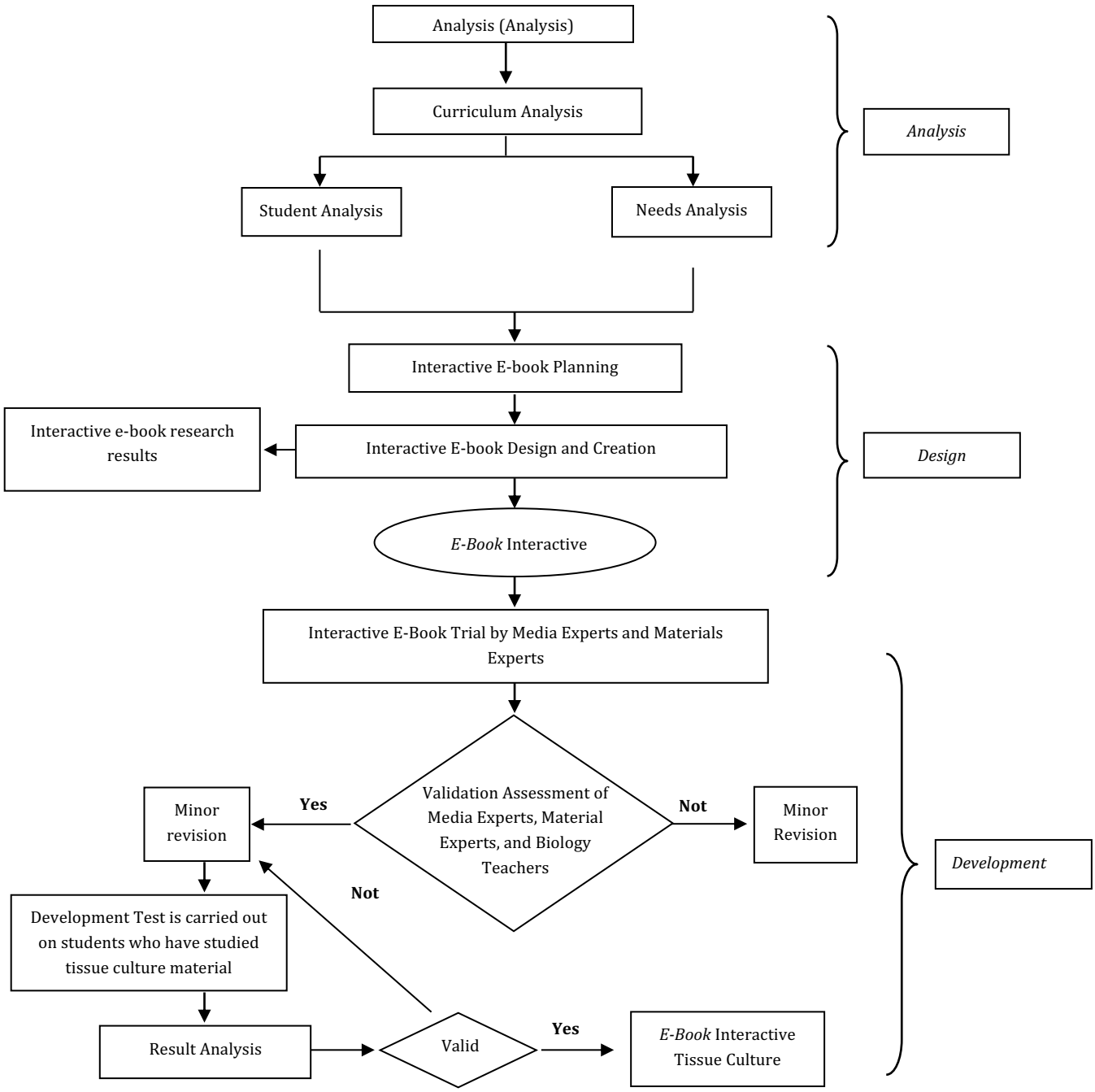


Figure 1. ADDIE (Analysis to Development) steps
Source: Mellisa & Yanda (2019)

Data Analysis Techniques

In development research, data validation results obtained from experts and analysis are used to determine the validity criteria of the developed product. The data analysis technique used the Likert Scale method. The Likert scale is a psychomotor scale used in questionnaires, expressing a person's attitudes and opinions toward a phenomenon. The Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena (Sugiyono, 2016).

The interactive e-book that has been produced is validated in advance by Biology Education lecturers and Biology class XI teachers. Respondents' responses in the form of quantitative data, expressed in the form of a range of answers ranging from 1 to 5, where 1 = if no descriptors appear, 2 = if only 1 descriptor appears, 3 = if only 2 descriptors appear, 4 = if all three descriptors appear and 5 = if all four descriptors occur. After all the respondents' answers have been collected, the total score of the respondents is calculated by finding the expected score for each aspect of the assessment and all aspects. The components of the assessment aspects that were observed included aspects of learning, material, presentation, appearance, and integration. After being validated by material experts, media experts, and teachers, learning media is assessed, commented on and given suggestions by students. Furthermore, percentages are made so that conclusions can be drawn on how appropriate the e-book is to be used. The formula for analyzing the validity level of expert validators, users, and group tests can be used as follows:

$$V = \frac{TSe}{TSh} x100\%$$

Information :
V = media validation
TSe = Total score achieved
Tsh = Maximum expected total score

After the results of each validation test are known, to obtain conclusions from all the validity results of each expert, teacher, and student, it can be adjusted or confirmed with validity criteria as shown in Table 4.

Table 4
Validity Criteria of Validator and Product Assessment Results by Teachers

No.	Percentage Scales	Criteria
1.	85.01%-100%	Very valid, can be used without repair
2.	70.01%-85%	Fairly valid, and usable but needs minor improvements
3.	50.01%-70%	Invalid needs major improvement
4.	01.00%-50%	Invalid, can't be used

(Akbar, 2013)

While the results of calculating student responses are included in the categories and criteria can be seen in Table 5.

Table 5
Table 5.Criteria for the Percentage of StudentsResponse Questionnaires

No.	Percentage Scales	Criteria
1.	85.01%-100%	Very well
2.	75.01%-85%	good
3.	60.01%-75%	Pretty good
4.	55.01%-60%	not good
5.	55%	not very good

(Akbar, 2013)

RESULTS AND DISCUSSION

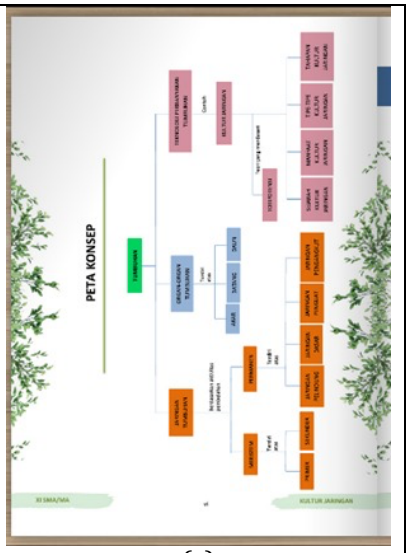
This study uses the ADDIE model design which consists of 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation. In this study, researchers only carried out the analysis stage to the development stage, this was done by researchers to save time and costs.

The result of this development is an interactive e-book in the form of a flip builder website (https://online.flipbuilder.com/mvejr/kzit/) that contains material regarding the Structure and Function of Tissues in Plants, the sub material of tissue culture. This interactive e-book can be accessed online. This interactive e-book contains material, practice questions and is also accompanied by a video about tissue culture. This interactive e-book consists of a cover, introduction, and content. The cover

contains an interactive e-book identity, title, educational unit level, and author's name. The introduction contains the title page, preface, instructions for using the interactive e-book, core competencies, and basic competencies, table of contents, list of pictures, and concept maps. The content containing material is divided into 3 chapters and accompanied by pictures, at the end of each chapter there is a summary and practice questions and in the last chapter, there is a video about the stages of tissue culture work.

(a)

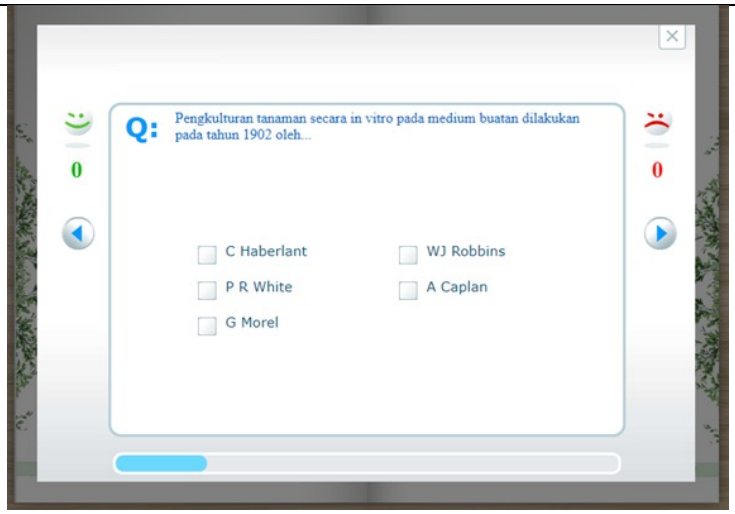
(b)



(c)

(d)

(e)



(f)

(g)

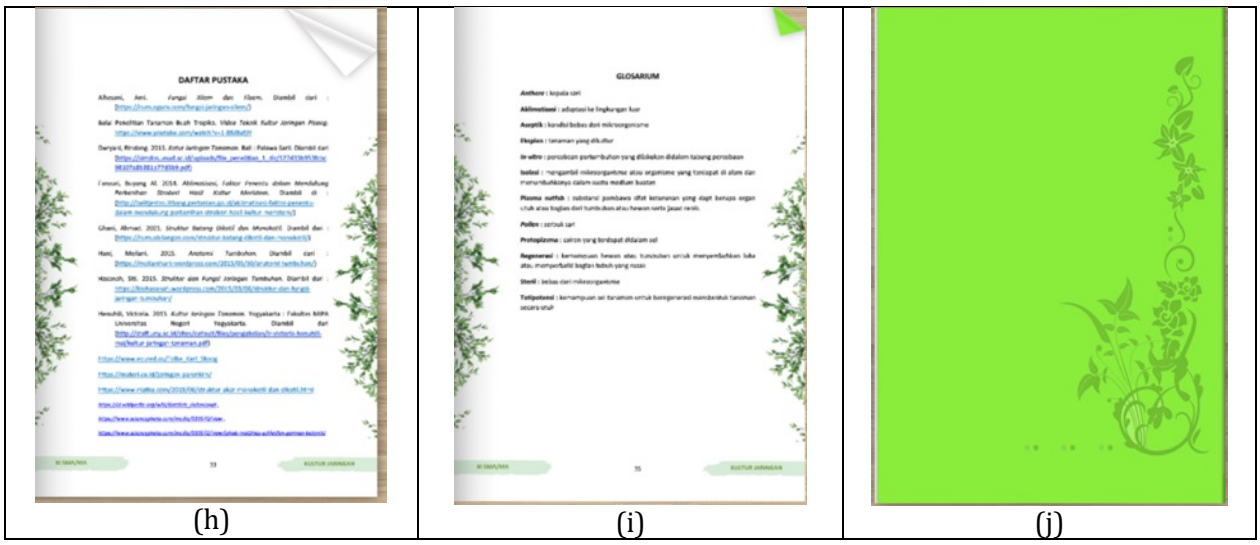


Figure 2. Front cover display (a), title page (b), concept map (c), content display (d), material summary (e), practice questions (f), video display (g), bibliography (h)), glossary (i), back cover view (j)

Learning Media Validation by Media Experts

Media validation is carried out by displaying interactive e-books using a laptop and also providing interactive e-book links so that they are easy to view and assess as well as providing validation sheets to media experts. The results of the validation of interactive e-book learning media by media experts are presented in Table 6

Table 6.
Validation Results of Interactive E-Book Learning Media by Media Experts

No.	Name Validators	Rated Aspect	Eligibility Percentage (%)	Validity Level
1.	RMC	Appearance	91.58%	Very Valid
		Programmer	96.92%	Very Valid
2.	LR	Appearance	87.37%	Very Valid
		Programmer	85.33%	Very Valid
The Media Expert's Average Assessment Of All Aspects			90.30%	Very Valid

Based on Table 6, it can be seen that the assessment of interactive e-book learning media by two media experts was carried out in one stage of assessment and had a very valid level of validity. The very valid criterion means that the media being developed already has maintainable components (can be managed easily), usability (easy to use and simple to operate), compatibility (learning media can be used with a variety of existing hardware and applications), reusable (can be reused). , communicative, creative in idea, simple, and interesting (Tiwi & Mellisa, 2023).

Based on the percentage of display aspects obtained from media experts, it can be judged that the interactive e-book cover design is appropriate to the material and interesting, the text selection in the interactive e-book is easy to read, the videos and images presented are clear and can help students understand the material, the video back sound is not distracting, and this interactive e-book can help students learn independently at home. On the display aspect, the media expert validator (RMC) suggested that the answer option exercise should not use options A, B, C, D, and E because the answer to the exercise can be clicked directly on the display. The media expert validator (LR) suggests adding a start page as an e-book identity, adding concept maps, KI, and KD, and also adding e-book usage instructions to make it easier for users to use and understand interactive e-books. In addition, the media expert validator (LR) also suggests adding a reference source to each image and video contained in the interactive e-book and adding an information corner to provide additional information to users.

Based on the percentage of programming aspects obtained from media experts, it can be assessed that on the maintainable indicators, interactive e-book learning media is easy to manage and links and text boxes can be accessed. In the usability indicator, it can be seen that the interactive e-book learning

media is easy to use, the navigation buttons on the interactive e-book correspond to the intended link, the program menu is easily accessible, the use of interactive e-book learning media does not require changes to the computer, laptop, and smartphone settings. In the compatibility indicator, it can be seen that accessing the interactive e-book learning media does not require a special application, the interactive e-book learning media can be accessed using a computer, laptop, or smartphone.

E-books are materials that are easily updated and the content is presented in a variety of easy-to-obtain multimedia. Besides the fact that temporal and spatial boundaries do not preclude the transfer of content to students, content can be accessed via the Internet. An interactive e-book is an integrated learning environment with multimedia and activities. Interactive e-books allow interaction through various channels, such as interactions between users and digital books or books and learning environments (Shemy, 2021).

Rosyidah (2022)states that interactive e-books have the advantage that they can be applied in online learning because they are equipped with interesting features and can be connected online via a computer/laptop or smartphone, there are pictures, videos that can be accessed online or offline, hyperlinks linked to the internet, creative games connected to the internet that can respond, linked icons on answer sheets to facilitate evaluation, there are also Google Scholar references that can be explored in detail. Free to add student insights, and there is a Google form, and email to collect student assignments.

Learning Media Validation by Material Experts

Material validation is seen from the sequence of materials and study materials. Material validation is done by providing printouts of e-books and displaying e-books through laptops to view videos and practice questions. The results of the validation of interactive e-book learning media by material experts are presented in Table 7 below:

Table 7.
Validation Results of Interactive E-Book Learning Media by Material Experts

No.	Name Validators	Rated Aspect	Indicators	Percentage Before Revision	Percentage After Revision	The Average Percentage Of Eligibility (%)	Validity Level
1.	M	Content Eligibility	Continuity	80%	100%	90%	Very Valid
			Study Materials	80%	92%	90%	Very Valid
Average				84.44%	95.56%	90%	Very Valid

Based on Table 7, it can be seen that the validation of learning media by material experts has a level of validity that is very valid. Based on the percentage on the traceability indicator, it can be seen that the learning material in the interactive e-book has not been systematically arranged so it requires a revision in the systematic arrangement of the interactive e-book learning material. In the percentage of indicators of study materials, it can be seen that the description of the material is following scientific concepts, and pictures and videos can help students understand the material. On the aspect of content feasibility, especially on the traceability indicators, material experts provide suggestions to improve the systematic arrangement of material in interactive e-books and also writing errors. In addition, the material expert also suggested adding NPM under the name of the researcher as the identity of the interactive e-book.

Based on research by Hanifah et al., (2019) the development of e-books can be said to be feasible if the e-books developed are based on the applicable curriculum, correct and appropriate theories, the material presented in detail, and follow the cognitive range of students who are learning. The development of learning media, for example, such as e-books, has a relationship between learning strategies and the material to be presented. Media functions as an aid in teaching and learning activities in the form of tools that can provide visual experiences to students to encourage learning motivation, simplify complex concepts, and clarify and abstract them into simpler, concrete, and easy to understand. Media also functions to increase children's absorption and retention of learning concepts(Schmidt, 2020). according to Surata et al., (2020), the accuracy of making learning media with the type and characteristics of the material is very important to produce an optimal learning process in addition to the needs of students. Not all types of media are efficient for all types of biological materials, depending on the characteristics of the material. Learning media provides opportunities for students to learn more independently, do repetition after evaluation, and enrich understanding by exploring the material being studied further.

Learning Media Validation by Learning Experts

The validation of learning is seen from the arrangement of the display, language, and readability. Validation is done by providing a printout of the e-book and providing an e-book link. The results of the validation of interactive e-book learning media by learning experts are presented in Table 8 below

Table 8.
Validation Results of Interactive E-Book Learning Media by Learning Experts

No.	Name Validators	Rated Aspect	Eligibility Percentage (%)	Validity Level
1.	NKH	Display Layouts	94%	Very Valid
		Language	80%	Quite Valid
		Readability	100%	Very Valid
The Average Assessment of Learning Experts on All Aspects			91%	Very Valid

Based on Table 8, it can be seen that the validation of learning media by learning experts has a level of validity that is very valid. From the validator (NKH) the aspect of the display arrangement gets a percentage of 94% with a very valid level of validity so from the aspect of the display it is very valid to use. Based on the percentage of display aspects obtained from learning experts, it can be judged that the appearance of the e-book cover is attractive and follows the material, the video display is clear and supports the material, the image display already represents the material but there are still some sources of images that are still incomplete, the learning objectives are not systematic. , learning objectives and KD are appropriate, learning objectives and materials are appropriate, the language used is still a little difficult for students to understand, and e-books are easy to read. Based on research (2018) that based on rapidly developing technology e-books should contain learning videos, animations, audio, and images. The contents of the e-book are not monotonous, interesting, and interactive, and can train students' thinking skills in using e-books.

Based on the percentage of language aspects obtained from learning experts the language used is quite clear, following EYD, the language used is communicative, but the language used is still a little difficult for high school/MA level students to understand. Expert validator learning suggests using language that is easy to understand for high school level students. Based on research Astashina (2019) that the advantages of e-books in addition to being seen in terms of grammar, vocabulary, language terms, and possessed skills, e-books can make readers more interested in the learning process.

Based on the percentage of readability aspects obtained from learning experts the typeface and font size used can be read properly so that the e-book is easy to read clearly. According to Fitri (2022), Readability can be interpreted as the level of difficulty or ease of reading. So it is necessary to adjust the readability to the level of the reader. Therefore, it can be said that legibility can affect the ability of students, so it is necessary to arrange good sentences and choose words that are easy to understand and do not cause double meanings. Based on research conducted by Yudasmara (2015) proves that the use of interactive learning media in learning can improve learning outcomes and student motivation. This happens because this media becomes better for learning. When students can learn quickly, they will accelerate ongoing learning leading to the next lesson. However, when a student experiences difficulties in his learning process, he can give more time for learning. Based on this, computers and learning media allow students to individualize learning by controlling the pace and sequence of their learning, which gives them more control over the results they achieve.

Learning Media Validation by Biology Teachers

This research was conducted by providing an interactive e-book link and also a printout of the e-book to be viewed, observed, and provided validation sheets to biology subject teachers. The results of the research on interactive e-book learning media by teachers are presented in Table 9.

Based on Table 9, it can be seen that the overall assessment of interactive ebook learning media by the teacher has a level of validity that is very valid with a percentage of 95.19%. The teacher's response was obtained by using an instrument in the form of a response questionnaire to the media given to the three Biology teachers in class XI. Based on the percentage aspect of the display layout obtained from the three Biology teachers, it can be seen that the interactive ebook learning media developed by the researcher has an attractive cover appearance, the material presented is following the learning objectives and competencies of students, and the material presented is sequential. Based on the percentage obtained, it can be seen that the language used is clear and communicative, and the sentences have been

arranged according to the EYD. Based on the percentage obtained, it can be seen that the typeface and font size used in the interactive e-book can be read, the images presented are following the material and help understand the material, the descriptions on each image help to understand the material, and the videos presented are following the learning material.

Table 9.
Validation Results of Interactive E-Book Learning Media by Biology Teachers

No.	Rated aspect	Percentage of eligibility (%)			Average (%)	Validity Level
		ASH	YH	E		
1.	Display layouts	93.33%	93.33%	93.33%	93.33%	Very Valid
2.	language	100%	95%	95%	96.67%	Very Valid
3.	Readability	100%	90%	96.67%	95.56%	Very Valid
Average teacher assessment of all aspects		96.36%	94.55%	92.73%	95.19%	Very Valid

According to Ummi (2018), one of the external factors that can improve the quality of education is the use of learning media. With the media, it is hoped that the learning process will be easier for students and teachers because learning media can overcome the limitations of space and time in learning. The use of learning media can also motivate students to learn. However, at the time of implementation of learning the use of learning media was not optimal. This is due to the lack of variety of media used by teachers in subjects. Teachers are still fixed on books or modules given to students so that the enthusiasm of students to practice becomes low.

Student Responses

At this stage, the media used is media that has been revised and its shortcomings corrected according to the results of validation and suggestions given by media experts, material experts, and learning experts. The instrument for students consists of 32 statements consisting of 4 aspects, namely the appearance aspect, the language aspect, the material aspect, and the benefit aspect. Student response data was collected by providing opportunities for students to view interactive e-book learning media by sending an interactive e-book link to class groups and students assessing by filling out a Google form link. Data on the results of the assessment of student responses are presented in Table 10 below:

Table 10.
Student Response Results

No.	Rated aspect	Percentage of eligibility (%)			Average (%)	Eligibility Level
		SE1	SE2	SE3		
1.	appearance	79.06%	80.31%	79.22%	79.53%	good
2.	language	79.11%	83.11%	78.22%	80.15%	good
3.	theory	77.78%	83.78%	76.67%	79.41%	good
4.	Benefits	79.33%	81.56%	79.11%	80.52%	good
Average teacher assessment of all aspects		78.88%	81.45%	78.63%	79.75%	good

Based on Table 10, it can be seen that the average percentage of student responses in the three schools as a whole is 79.75% and has a level of validity indicated in the Good category. Based on student response data from the three schools, it can be concluded that the network culture interactive e-book learning media developed by researchers is good for use with good eligibility criteria and gets a positive response from students. It can be seen from the results of the response data from students in each school differently. In this case, researchers must also pay attention to suggestions and comments given by students so that the learning media developed can be even better.

The students stated that using the interactive e-book on plant tissue culture in the teaching and learning process could increase their motivation to learn, become more interested in following the lesson, and find it easier to understand the material. In addition, this interactive e-book learning media for plant tissue culture can be accessed anytime and anywhere so that students can learn independently. In addition to the positive responses, there were several comments/suggestions from students regarding the display of this interactive e-book.

From the data from student responses, it can be seen that using this interactive e-book learning media can increase learning motivation and help them understand the material. In addition, it also makes it easier for students to learn independently. Based on research conducted by Khairinal et al (2021)states that the developed e-book can help students understand learning material and is not boring because it is in the form of audiovisual media which contains pictures, audio, and video which can increase student interest, that because it applies technology so that learning can be accessed using laptops, computers, or android online and can be used independently by students. Other supporting statements are stated by Asyhar, (2012) that the use of learning media provides new knowledge to students to increase the participation and activeness of students in the entire learning process. Hamalik (2015) argued that one of the principles of teaching and learning is that students learn by making the availability of media in their learning will produce students who are different from classes that do not provide media in their learning. Students who learn to use media will be much more active than students who never use media in learning.

Based on research conducted by Surata et al., (2020) stated that the most widely used types of learning media were audio-visual/video and multimedia media. This is because in biology there is more material in the form of theories, concepts, processes, and some simple calculations which are of course explained in the form of audio-visual media. Multimedia is easier to use by involving a concept test process after the material has been studied by students. Multimedia is a learning media in which it contains various media, both audio, and visual, and/or quizzes/tests which are generally displayed in an interactive and user-friendly manner. Multimedia makes it easier for students to understand the concept of the material and check their mastery of the material.

Overall, the results of the study indicate that the development of interactive e-book learning media in learning network culture for students of class XI IPA SMA/MA Pekanbaru City is categorized as very valid. The determination of this category is obtained from the average percentage of assessments from the validation sheet of media experts, material experts, learning experts, biology teachers, and student response questionnaires that have been described previously so that this interactive e-book learning media can be used in learning biology at school.

CONCLUSION

Based on the results of the study, it can be concluded that the results of the evaluation of interactive e-book learning media on the subject matter of Structure and Function of Tissues in Plants, the Tissue Culture sub material that was developed as a whole are very valid with the percentage of media expert validation results of 90.30% (very valid), material experts 90% (very valid), learning experts 94% (very valid) and biology teachers 95.19% (very valid). The interactive e-book learning media received good responses from students. This can be seen from the average percentage of student responses from the three schools of 79.75% (good). So that from the overall assessment, the average percentage of all validators is 91%.

REFERENCES

Akbar, S. (2013). *Instrumen perangkat pembelajaran*. PT. Remaja Rosdakarua Offset.

Astashina, M. S. (2019). The language course is not just a book. It is a complex set of educational components. *Язык и текст*, *6*(4), 66-71. https://doi.org/10.17759/langt.2019060409

Asyhar, R. (2012). *Kreatif Mengembangkan Media Pembelajaran*. Referensi Jakarta.

Chang, S. C., Wang, S. Y., & Hwang, G. J. (2016). A repertory grid-based interactive e-book approach to supporting in-field mobile learning activities in an ecology course. *International Journal of Mobile Learning and Organisation*, *10*(3), 171-186. https://doi.org/https://doi.org/10.1504/IJMLO.2016.077868

Chang, W. H., Huang, T. H., & Liu, Y. C. (2018). Influence of an Interactive e-Book on the Reading Comprehension of Different Ethnic Groups Using Indigenous Culture as Content. *International Journal of Human– Computer Interaction*, *35*(4), 323-332. https://doi.org/https://doi.org/10.1080/10447318.2018.1543079

Dwiyani, R. (2015). Kultur Jaringan Tanaman. In *Journal of Chemical Information and Modeling*.

Fitri, H. M. M., & Rahayu, Y. S. (2022). Pengembangan E-Book Berbasis Inkuiri Terbimbing pada Materi Pertumbuan dan Perkembangan Tumbuhan untuk Melatihkan Kemampuan Berpikir Kritis Siswa Kelas XII SMA. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *11*(1), 28-38. https://doi.org/10.26740/bioedu.v11n1.p28-38

Gui, X. (2019, April). The Design and Creation of an Interactive E-Book:"Book of Answer". In *Journal of Physics: Conference Series* (Vol. 1187, No. 5, p. 052018). IOP Publishing. https://doi.org/10.1088/1742-6596/1187/5/052018

Hamalik, O. (2015). *Kurikulum dan Pembelajaran*. Bumi Aksara.

Hanifah, H., Supriadi, N., & Widyastuti, R. (2019). Pengaruh model pembelajaran e-learning berbantuan media pembelajaran edmodo terhadap kemampuan pemecahan masalah matematis peserta didik. *NUMERICAL: Jurnal Matematika Dan Pendidikan Matematika*, 31-42. https://doi.org/10.25217/numerical.v3i1.453

Hasan, M. F., Suyatna, A., & Suana, W. (2018). Development of interactive e-book on energy resources to enhance student's critical thinking ability. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, *3*(2), 109-121. https://doi.org/10.24042/tadris.v3i2.3114

Hendratno, H., Yermiandhoko, Y., & Yasin, F. N. (2022). Development of Interactive Story Book For Ecoliteration Learning to Stimulate Reading Interest in Early Grade Students Elementary School. *IJORER : International Journal of Recent Educational Research*, *3*(1), 11–31. https://doi.org/10.46245/ijorer.v3i1.179

Himmah, E. F. (2019). Pengembangan E-modul menggunakan Flip PDF Professional pada Materi Suhu dan Kalor. *Universitas Islam Negeri (Uin) Raden Intan Lampung*.

Khairinal, K., Suratno, S., & Yulia Aftiani, R. (2021). Pengembangan Media Pembelajaran E-Book Berbasis Flip Pdf Professional untuk Meningkatkan Kemandirian Belajar dan Minat Belajar Siswa pada Mata Pelajaran Ekonomi Siswa Kelas X IIS 1 SMA Negeri 2 Kota Sungai Penuh. *JMPIS : Jurnal Manajemen Pendidikan Dan Ilmu Sosial*, *2*(1), 458–470. https://doi.org/10.38035/jmpis.v2i1.583

Maryanti, S., & Kurniawan, D. T. (2018). Pengembangan Media Pembelajaran Video Animasi Stop Motion Untuk Pembelajaran Biologi Dengan Aplikasi Picpac. *Jurnal BIOEDUIN : Program Studi Pendidikan Biologi*, *8*(1), 26–33. https://doi.org/10.15575/bioeduin.v8i1.2922

Mellisa, & Imania. (2022). Pengembangan E-Modul Berbasis Canva Pada Materi Pencemaran Lingkungan Di Kelas VII SMPN Pekanbaru. *Jurnal Pendidikan Dan Konseling*, *4*(5), 6234–6241. https://doi.org/https://doi.org/10.31004/jpdk.v4i5.7696

Mellisa, M., Nissa, C., & Saputri, D. (2023). Developing a video-animated learning media of the human skeletal system using Powtoon. *Research and Development in Education (RaDEn)*, *3*(1), 1–15. https://doi.org/10.22219/raden.v3i1.23315

Mellisa, M., & Yanda, Y. D. (2019). Developing audio-visual learning media based on video documentary on tissue culture explant of Dendrobium bigibbum. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *5*(3), 379–386. https://doi.org/10.22219/jpbi.v5i3.9993

Ebied, M. M. A., & Rahman, S. A. A. (2015). The Effect of Interactive e-Book on Students' Achievement at Najran University in Computer in Education Course. *Journal of Education and Practice*, *6*(19), 71-82. https://eric.ed.gov/?id=EJ1079544

Molenda, M. (2015). In Search Of The Elusive Addie Model. *Performance Improvement*.

Purbalingga, G. (2020). *Flip Pdf Corporate Edition*.

Putri, R. A., Uchtiawati, S., Fauziyah, N., & Huda, S. (2020). Development of Interactive Learning Media Flip-Book Using Kvisoft Flipbook Maker Based on Local Culture Arts. *Innovation Research Journal*, *1*(1), 55. https://doi.org/10.30587/innovation.v1i1.1442

Rafli, Y., & Adri, M. (2019). Pengembangan Modul Berbasis E-book Interaktif pada Mata Pelajaran Dasar Desain Grafis. *VOTEKNIKA : Jurnal Vokasional Teknik Elektronika Dan Informatika*, *7*(1). https://doi.org/10.24036/voteteknika.v7i1.103787

Rosyidah, I., & Rahayu, Y. S. (2022). Pengembangan E-Book Interaktif Berorientasi Contextual Teaching and Learning untuk Melatihkan Keterampilan Berpikir Kreatif pada Materi Pertumbuhan dan Perkembangan Tumbuhan. *Bioedu*, *11*(1), 49–59. https://doi.org/10.26740/bioedu.v11n1.p49-59

Schmidt, S. J. (2020). Distracted learning: Big problem and golden opportunity. *Journal of Food Science Education*, *19*(4). https://doi.org/10.1111/1541-4329.12206

Setiyanigrum, R., Susilaningsih, E., & Setyaningsih, N. H. (2022). Development of Interactive E-books on Plane Figures Materials to Improve Problem Solving Ability of Grade IV Students. *International Journal of Research and Review*, *9*(2), 297–307. https://doi.org/10.52403/ijrr.20220240

Shemy, N. (2021). The Effectiveness of Interactive E-Books in the Development of Scientific Concepts During “Science Course” and Its Relation To the Difference of Cognitive Style (Verbal/Visual) in Students. *European Journal of Open Education and E-Learning Studies*, *6*(1), 60–78. https://doi.org/10.46827/ejoe.v6i1.3570

Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif,dan R&D*. Alfabeta.

Surata, I. K., Sudiana, I. M., & Sudirgayasa, I. G. (2020). Meta-Analisis Media Pembelajaran pada Pembelajaran Biologi. *Journal of Education Technology*, *4*(1). https://doi.org/10.23887/jet.v4i1.24079

Suryani, E., & Khoiriyah, I. S. A. (2018). Pemanfaatan E-book sebagai Sumber Belajar Mandiri bagi Siswa SMA/SMK/MA. *International Journal of Community Service Learning*. https://doi.org/10.23887/ijcsl.v2i3.15422

Suryani, N., Setiawan, A., & Putria, A. (2018). Media Pembelajaran Inovatif dan Pengembangannya. In *Sifonoforos* (Vol. 1, Issue April).

Tania, L., & Fadiawati, N. (2015). The development of interactivee-book based chemistry representations referred to the curriculum of 2013. *Jurnal Pendidikan IPA Indonesia*. https://doi.org/10.15294/jpii.v4i2.4186

Tiwi, D. I., & Mellisa, M. (2023). Pengembangan Video Pembelajaran Berbasis Aplikasi Capcut pada Mata Kuliah Kultur Jaringan. *Jurnal Inovasi Pembelajaran Biologi*, *4*(1), 39–45. https://doi.org/10.26740/jipb.v4n1.p39-45

Ummi, A. (2018). Pengembangan Media Pembelajaran Biologi Semester II Kelas X SMA Berbasis Lectora Inspire. *Jurnal Nalar Pendidikan*, *6*(1), 41. https://doi.org/10.26858/jnp.v6i1.6041

Wulandari, T. A. J., Sibuea, A. M., & Siagian, S. (2019). Pengembangan Media Pembelajaran Berbasis Multimedia Interaktif Pada Mata Pelajaran Biologi. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, *5*(1), 75–86. https://doi.org/10.24114/jtikp.v5i1.12524

Yudasmara, G. A., & Purnami, D. (2015). Pengembangan Media Pembelajaran Belajar Siswa SMP. *Jurnal Pendidikan Dan Pengajaran*.