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Development of Electronic Pocketbook Media on Plant-like Protist for Class X Senior High School

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ABSTRACT

Purpose of the Study: This study aimed to develop and validate an innovative electronic pocketbook on plant-like protists, designed for use by class X Senior High School students. The pocketbook integrates real-world examples of phytoplankton research from the Teluk Nibung River, offering a modern and engaging learning tool that enhances students' understanding of plant-like protists.

Methodology: The research employed a Research and Development (R&D) method, encompassing three stages: pre-production, production, and post-production. Validation was conducted using questionnaire sheets with a Guttman scale, assessed by two lecturers. Additionally, media validation sheets, covering format, content, language, and practicality, were evaluated using a Likert scale by two lecturers and three biology teachers.

Main Findings: The electronic pocketbook contains comprehensive material on plant-like protists, enriched by real phytoplankton research results from the Teluk Nibung River. The pocketbook includes essential components such as cover, preface, instructions, table of contents, material content, bibliography, glossary, and author profile. The validation results yielded a CVI value of 1.00, indicating that the pocketbook is valid and suitable as a learning medium for plant-like protists in class X biology.

Novelty/Originality of this Study: This study presents a unique approach by integrating phytoplankton research into the curriculum through a digital format. The electronic pocketbook offers flexibility by being accessible both online and offline, and can be downloaded using free applications, providing students with a practical and innovative tool for learning. The incorporation of real-world data not only enhances engagement but also bridges the gap between theoretical knowledge and field research.

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1. INTRODUCTION

Along with the advancement of science and technology, 21st century learning demands a wider application of technology in Indonesia, including in the field of education. Technological advances in education are utilized to support efficient learning, such as the utilization of technology for distance learning [1]. With the demands of technology application in 21st century learning, teachers can optimize the use of technology appropriately in the learning process. For example, the need for learning implementation was not only offline, but can also be implemented online which requires teachers to be able to develop technology-based or electronic

learning tools. Based on Dewi and Hilman, technology-based media used in learning can increase student interest and learning outcomes in class, and be more effective in the learning process in class [2]. Based on the results of previous research, the use of ICT-based media can improve student learning outcomes which can be shown by an increase in student responses to ICT-based learning media [3].

The development of technology-based or electronic learning tools can be adjusted to the needs and characteristics of students, the type of concepts to be taught, and the facilities available at school. One of the subjects that was difficult for students to understand was biology because it contains many abstract materials concepts and many scientific terms that are unfamiliar to students [4], [5]. In addition, the concept of biology physiologically (anatomy, morphology, ecology, biochemistry) was also considered difficult for students as seen in research [6]. For example, Protista material is material that is difficult for students to understand because it has a fairly broad scope and there are many scientific terms and objects that must be studied are mostly microscopic so that real object observations need to be made [7], [8]. In addition, the objects observed are also difficult to find or observe directly because they generally live in water and are microscopic [9].

Part of the Protista material was plant-like protists known as algae. Algae were divided into unicellular diatoms (also called phytoplankton) and multicellular seaweed. Phytoplankton is a microscopic organism that floats in the water so that its movement follows the water current [10]. Its existence has a very important role in a water body by providing food needs for other species at higher trophic levels [11]. The composition and abundance of certain phytoplankton in a water body was instrumental in providing natural food at the upper trophic level and oxygen provider in a water body [12]. Therefore, a decrease in the number and type of phytoplankton will affect organisms at the upper trophic level and can indicate water quality [13]. The types of phytoplankton as the content of plant-like protists cannot be seen directly because of their microscopic (unicellular) form. Given the important role of phytoplankton as the main producers in aquatic ecosystems, the information is also very important for students to know and understand well. In addition to increasing knowledge and providing real experience in learning, students can also realize the importance of phytoplankton for the environment and can increase student awareness to protect the environment, especially the aquatic environment as a phytoplankton habitat and in accordance with contextual learning. Biology learning with a contextual approach can increase students awareness to care for the environment [14].

Phytoplankton was taught in class X Senior High School with the expected basic competency was KD 3.5, namely students were able to classify Protista based on general characteristics of the class and associate their role in life. Based on the demands of Curriculum 2013, students were asked to make observations through practicum or learning media that can describe the original shape and color of phytoplankton. Based on interviews with class X biology teachers at Senior High School Negeri 1 Rasau Jaya on June 23, 2022, learning Protista material, especially plant-like Protista, was not accompanied by practicum due to constraints on laboratory facilities, especially microscopes and narrow time allocations for practicum implementation. On the other hand, teachers have dealt with the demands of observation according to KD by using media in the form of printed pictures accompanied by the names of phytoplankton species and video shows containing the characteristics of phytoplankton in general at the division level. The image and video media used are sourced from the internet where the level of validity of the content is not necessarily accountable or the type of phytoplankton given was not necessarily found in Indonesian waters. In addition, the achievement of student learning outcomes that have reached the teaching completeness criteria (KKM) value is only around 30-40% at KKM = 75. This means that the media used has not fully helped students to understand the plant-like Protista material so it was necessary to develop alternative learning media to meet learning needs that refer to the syllabus and can support the demands of 21st century learning related to the application of technology.

Learning media was a tool to channel information or learning concepts that the teacher wants to convey to students so that the material was easier to understand and can arouse students' concentration and interest in learning so that the expected learning objectives can be achieved [3]. Learning media should be able to visualize abstract and microscopic concepts to be concrete or real and can be enlarged, for example by utilizing the advantages of information and communication technology (ICT). ICT-based media development can also support the demands of 21st century learning. In addition, the increasing ownership of devices after the implementation of online learning during the Covid-19 pandemic also increases the potential for ICT-based learning media alternatives. However, the use of technology has limitations such as the availability of electricity and internet networks [15], nevertheless it can reduce printing costs, be effective in the learning process, and efficient in media storage [16].

Electronic pocketbooks were one of the alternative media that can help students understand the concept of plant-like Protista or phytoplankton sub-matter based on technology. An electronic pocketbook was a pocketbook displayed on a digital screen with an attractive and practical appearance that was easily accessible with a device and contains text or image information [17], [18]. The content of electronic pocketbook is usually written in simple, consists, follow by intersting picture. Electronic pocketbooks can be used effectively in learning and were suitable as media that attract student interest in learning because there were various variations of background colors, displaying diverse images according to the material [19]. Thus, electronic pocketbook

media can be used as one of the modern learning media that can support technological developments and meet the needs of students in understanding abstract learning concepts. Based on these considerations, it was necessary to develop electronic pocketbook media enriched with the results of phytoplankton research that was more contextual. The purpose of this research was to develop electronic pocketbook media on plant-like protist sub-material class X Senior High School. Technology-based media that can be used offline and online was expected to overcome the limitations of the internet network, provide a factual picture of phytoplankton, its characteristics and classification and its role in the environment.

2. RESEARCH METHOD

This research was conducted in February-September 2023 at the Faculty of Teacher Training and Education, Tanjungpura University. This study used the research and development (R&D) method. The development model refers to Suryani, Setiawan, & Putria with 3 stages, namely pre-production, production, pasca-production (Figure 1) [20]. In the pre-production stage, needs analysis, formulation of instructional objectives, and determination of materials to be included in the learning media in the form of electronic pocketbooks were carried out. Next, the production stage began with determining the media format, creating a script format, flowchart, and storyboard, followed by designing material descriptions taken from various references in the form of textbooks and scientific articles. In the production stage, the material was also put into the media product. In the pasca-production stage, editing, validation, and revision of the product were carried out according to the sugesstion from the validators.

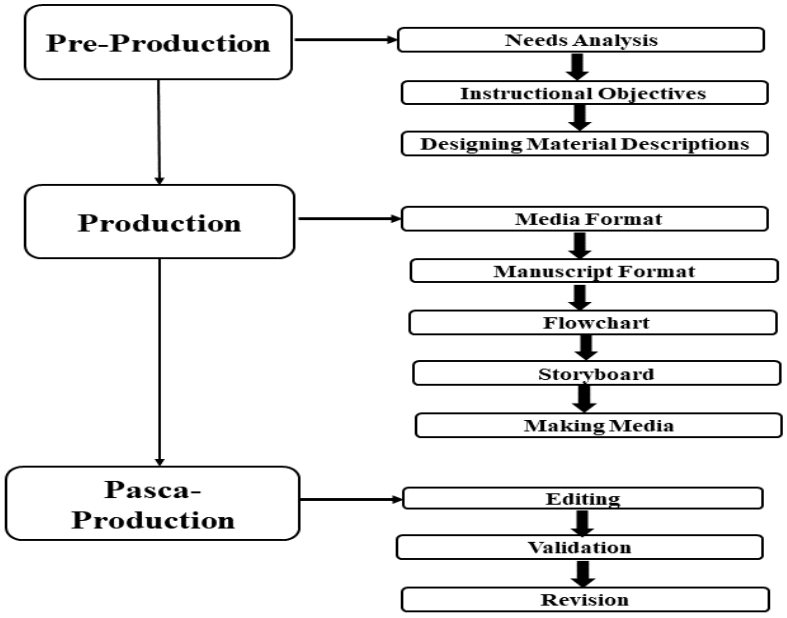

Figure 1. Stages of making electronic pocketbook media used in this study

The tools and materials used in making electronic pocketbook media were laptops, computer applications (Canva, Microsoft PowerPoint, AnyFlip) and references or relevant sources in the form of textbooks or scientific articles on plant-like Protista material. The media content also included the results of research on phytoplankton diversity collected from Teluk Nibung River, Batu Ampar District, Kubu Raya Regency [21].

In the pasca-production stage, editing,validation and revision were carried out. Media validation was carried out in 2 stages, namely instrument validation and media validation. Instrument validation consisted of 4 aspects of assessment, namely the suitability of the criteria with the aspects being assessed, the sentences used in the statement are concise, concise and do not cause double meaning, the criteria were written systematically, and grammar was in accordance with Refined Spelling (EYD). Instrument validation was carried out by 2 validators, namely lecturers in the Biology Education Study Program at Faculty of Teaching Training and Education (FKIP), Tanjungpura University. The criteria for becoming a validator included lecturers from the biology education study program, competence in science and master in the field of making media. The instrument assessment used a Guttman scale (Yes/No) and can be stated to be valid or "Yes" if all aspects were assessed as appropriate by both validators.

Tabel 1. The Criterias and aspects of media validation

Aspect	Criteria
Format	1. Completeness of Electronic Pocketbook components
	2. Clarity of image/illustration quality in the Electronic Pocket Book
	3. Attractiveness of the appearance of the Electronic Pocket Book
	4. Readability of font type and size in the Electronic Pocket Book
	5. Appropriateness of layout appearance of images and text
Content	6. Conformity between the content of the Electronic Pocket Book and the learning objectives
	7. Correctness of the content and concepts contained in the Electronic Pocket Book.
	8. The sequence of information delivery in the Electronic Pocket Book
	9. The research results in the electronic pocketbook support the understanding of the material
	10. The suitability of the research results with the concept of electronic pocket book media content.
	11. Electronic pocket book media can be used as phytoplankton identification in Teluk Nibung River.
Language	12. The appropriateness of the words in the sentences with refined spelling (EYD).
	13. The suitability of sentence writing in the Electronic Pocket Book with good and correct grammatical guidelines.
	14. Clarity and appropriateness of language use at the Senior High School level equivalent in the Electronic Pocketbook
Practicality	15. Suitability of using the Electronic Pocket Book media for individuals, groups, or classes.
	16. Ease of accessing and using the Electronic Pocket Book media.
	17. The Electronic Pocket Book can be used online or offline with a file size of less than 150 Mb.
	18. The electronic Pocket Book media can be used repeatedly as long as the file does not error.

Furthermore, the validation of electronic pocketbook media was carried out by five validators consisted of two lecturers of Biology Education Study Program FKIP Tanjungpura University and three biology teachers of class X Senior High School from Senior High School Negeri 1 Rasau Jaya, Senior High School Negeri 5 Pontianak, and MAN 1 Kubu Raya. Validation of electronic pocket book media included 4 aspects, namely format (5 criteria), content (6 criteria), language (3 criteria) and practicality (4 criteria) with a total of 18 criteria (Table 1) [22, 23]. The criteria of validator for teachers inculed were biology subject teachers for grade X of high school who were competent and have experience in teaching high school level with school accreditation of "A". The validation results were analyzed by calculating the Content Validity Ratio (CVR) and Content Validity Index (CVI) [24]. The CVR formula used was as follows:

$$\mathbf{CVR} = \frac{\mathbf{Ne} - \frac{\mathbf{N}}{\mathbf{2}}}{\frac{\mathbf{N}}{\mathbf{2}}} \quad \dots (1)$$

Description:
CVR : Content Validity Ratio
Ne : Number of validators who agree on the criteria
N : Total number of validators

Next, calculating the CVI (Content Validity Index) value of each criteria or the average CVR value that has been calculated as a whole to describe the validity of all instrument items. The CVI formula used is as follows:

$$\boldsymbol{CVI} = \frac{\sum \boldsymbol{CVR}}{\sum \boldsymbol{n}} \quad \dots (2)$$

Description:
$\sum$CVR = sum of CVR scores
$\sum$n = number of items in all aspects

Conclusions were drawn based on the minimum value of [24] index, as follows: 1) If the CVI value $\geq$ 0.99 the electronic pocketbook media is said to be valid; 2) If the CVI value $\leq$ 0.99 the electronic pocketbook media is said to be invalid.

3. RESULTS AND DISCUSSION

3.1. Media Presentation and Content

Phytoplankton electronic pocket book media was made with a size of 14.8 x 10.5 cm (A6) with a total of 44 pages and portrait orientation. The electronic pocket book was begun with a cover that consisted of a cover, instructions for use, preface, table of contents, and learning objectives. In the core section, the electronic pocket book contains the main material about plant-like Protista which included understanding, grouping and its role and was continued with a description of the results of research on phytoplankton diversity in the Teluk Nibung River to introduce the types of phytoplankton found in these waters. In this section, phytoplankton diversity included an explanation of the phytoplankton classes (Bacillariophyceae, Dinophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae, and Xantophyceae) obtained from the Teluk Nibung River, and a description of the orders and examples of species from each class. In the closing section, it was filled with a bibliography, glossary, author profile, and media synopsis on the back cover (Figure 2). The glossary made it easy for students to re-understand important terms related to the contents of the electronic pocketbook media which were arranged alphabetically.

Figure 2. The presentation of the electronic pocketbook media developed in this study. a) Opening section: cover, instructions, and preface; b) Contents: protist material, plant-like protists, and phytoplankton diversity; c) Closing section: Glossary, bibliography, and back cover

Electronic pocketbooks were pocketbooks displayed on a digital screen that can be carried everywhere containing text or image information [17]. This digital media makes it easy for readers to read without space and time constraints effectively and efficiently [25]. The display of electronic pocketbook true online was seen in Figure 3.

Figure 3. Opening Pages Using Online Display of Electronic Pocketbook

Electronic pocket book media could be used offline in the form of .pdf and online in the form of a website link. In offline use, .pdf files could be opened for example by using the WPS Office application, PDF Reader, Adobe Acrobat Reader, Foxit, CamScanner if via a device. In online use, opening media required an internet network and was opened in the AnyFlip application. The disadvantages of opening online through AnyFlip were the absence of a download feature and several times popping up advertisements. However, using media online has features that make it easier for readers such as search, zoom in and zoom out, fullscreen, previous page and next page. The ease of offline and online access used in various devices will make it easier for readers to operate. One of the indicators supporting the use of media in learning was ease of operation [26].

In addition to ease of operation, the criteria for a good book was to have complete components, starting with the introduction, content, and closing [27]. This electronic pocket book had adjusted these three components. The presentation of factual data from scientific research results can support student learning in accordance with contextual learning that presents real or real information. Contextual learning is learning that links material with factual information so that it can be applied in everyday life [28]. Contextual learning incorporated into the media was the types of phytoplankton found in real life in Teluk Nibung River, Kubu Raya Regency. The presentation of phytoplankton types in the media was presented in the form of original images found by researchers [21].

Electronic pocketbooks were considered more practical to use. This was supported by Nabila, that digital pocketbooks were more practical and not easily damaged like printed books whose quality will be damaged due to long storage [29]. Electronic pocketbooks were also more effective because they can be accessed without time and place restrictions and easy to carry anywhere and read at any time [18]. In addition, electronic pocketbooks were considered to be able to increase students' interest in learning and learning outcomes. Electronic pocketbooks can be used effectively in learning and were suitable as media that attract students' interest in learning because there were various variations of background colors, displaying diverse images according to the material [19]. Digital pocketbooks were also considered effective on student interest and learning outcomes [30], [31].

Phytoplankton electronic pocketbook media contains plant-like protist sub-materials and phytoplankton diversity. The electronic pocketbook media made can increase student understanding and foster awareness to participate in protecting waters as phytoplankton habitat and realize the important role of phytoplankton for life and the aquatic environment. To find out that this electronic pocket book was a media used by students, it was necessary to conduct a feasibility test.

3.2. Validation of Electronic Pocketbook

The electronic pocket book media made was then validated to see its feasibility as a learning media for plant-like protist sub-matter. Validation was carried out in two stages, namely instrument and media validation. The results of the instrument validation showed that both validators approved all the criteria on the instrument.

Thus, the media validation sheets were suitable to be used to validate the Phytoplankton electronic pocket book media. The results of media validation by five validators were listed in Table 2.

Table 2. Electronic pocket book media validation results Phytoplankton electronic pocket book media validation results.

Aspect		Criteria	CVR	Desc
Format	1.	Completeness of Electronic Pocketbook components	1.00	Valid
	2.	Clarity of image/illustration quality in the Electronic Pocket Book	1.00	Valid
	3.	Attractiveness of the appearance of the Electronic Pocket Book	1.00	Valid
	4.	Readability of font type and size in the Electronic Pocket Book	1.00	Valid
	5.	Appropriateness of layout appearance of images and text	1.00	Valid
Content	6.	Conformity between the content of the Electronic Pocket Book and the learning objectives	1.00	Valid
	7.	Correctness of the content and concepts contained in the Electronic Pocket Book.	1.00	Valid
	8.	The sequence of information delivery in the Electronic Pocket Book	1.00	Valid
	9.	The research results in the electronic pocketbook support the understanding of the material	1.00	Valid
	10.	The suitability of the research results with the concept of electronic pocket book media content.	1.00	Valid
	11.	Electronic pocket book media can be used as phytoplankton identification in Teluk Nibung River.	1.00	Valid
Language	12.	The appropriateness of the words in the sentences with refined spelling (EYD).	1.00	Valid
	13.	The suitability of sentence writing in the Electronic Pocket Book with good and correct grammatical guidelines.	1.00	Valid
	14.	Clarity and appropriateness of language use at the Senior High School level equivalent in the Electronic Pocketbook	1.00	Valid
Practicality	15.	Suitability of using the Electronic Pocket Book media for individuals, groups, or classes.	1.00	Valid
	16.	Ease of accessing and using the Electronic Pocket Book media.	1.00	Valid
	17.	The Electronic Pocket Book can be used online or offline with a file size of less than 150 Mb.	1.00	Valid
	18.	The electronic Pocket Book media can be used repeatedly as long as the file does not error.	1.00	Valid
CVI			1.00	Valid

CVR: Content Validity Ratio CVI: Content Validity Indeks Desc: Description

The media validation assessment used four aspects that were assessed, namely format, content, language and practicality which showed that all aspects have reached the CVR value of 1.00 (Table 2). The first aspect was the format aspect which describes the physical form of the media display used. The format aspect consisted of five assessment criteria. The first criteria was the completeness of the Electronic Pocketbook components and obtained a CVR value of 1.00. The electronic pocket book component was complete, which consisted of a cover, book identity, preface, instructions for use, material content, bibliography, glossary, author profile, back cover. The electronic pocket book component refers to [32]. The second criteria was the clarity of the image/illustration quality in the Electronic Pocketbook. This criteria received a CVR value of 1.00. Images/illustrations in the electronic pocket book media already have good visual clarity. This was in accordance with research conducted by [33,34] which states that a good image display on the media can visualize the concepts to be conveyed to students/readers, and can clarify the material contained in the media so that it can facilitate learning achievement. The third criteria was the attractiveness of the appearance of the Electronic Pocketbook. This criteria obtained a CVR value of 1.00. This means that the appearance of the Electronic Pocketbook media was classified as attractive. An attractive media display equipped with appropriate images and color combinations can be used as nonverbal communication in delivering messages directly [35,36]. The fourth criteria was the readability of the type and size of the font in the Electronic Pocketbook and gets a CVR value of 1.00. The selection of fonts used in good visual media was letters that were upright, not connected, not diverse and easy to read in visual media displays [33,37]. One type of font that meets these criteria according to the validator was Times New Roman with font size 10-12 as used in the media. The fifth criteria was the suitability of layout, images and text. This criteria received a CVR value of 1.00. The layout of the image and text balance

was proportional. The layout combines elements or elements of graphic communication (images, text, tables and others) to make visual media communicative, aesthetic and attractive [34]. Based on the results of the validation analysis from five validators on the format aspect, the CVR value was 1.00. The format aspect showed valid results because the CVR value exceeds the minimum value [24].

The second aspect was the content aspect which describes the quality of the electronic pocket book media content. The content aspect consisted of six criteria. The first criteria was the suitability of the content of the Electronic Pocket Book with learning objectives and obtained a CVR value of 1.00. The media content was in accordance with the learning objectives. One of the indicators that support the quality of learning media was its suitability for learning objectives that were expected to be achieved efficiently and effectively [27,38]. The second criteria was the correctness of the content and concepts contained in the electronic pocket book and also obtained a CVR value of 1.00. The contents and concepts in the media have presented actual and relevant information based on clear references and sources, and contain factual information which was the result of research on phytoplankton abundance in the Teluk Nibung River. The information presented in the media must also be true, clear, and accurate so that readers can find relevant information [39,40]. The third criteria was the orderliness of information delivery in the Electronic Pocketbook which also received a CVR value of 1.00. The information in the Electronic Pocketbook media has been arranged coherently from general to specific information. The material presented in the media that was arranged systematically and sequentially can improve learning achievement [41]. The fourth criteria was that the research results in the electronic pocket book support the understanding of the material. This criteria received a CVR value of 1.00. The research results included in the media were factual information conducted in the Teluk Nibung River. Information that has a high value of actuality can increase readers' understanding and interest in the information presented. The fifth criteria was the suitability of research results with the concept of electronic pocket book media content which also received a CVR value of 1.00. In other words, the results of the research on phytoplankton abundance in the Teluk Nibung River were in accordance with the concept of electronic pocketbook media content. The species found in the six classes provide real information about the diversity of phytoplankton species in the Teluk Nibung River. Media that contains real information can provide direct experience to students by displaying real images so that students better understand the material [42]. The sixth criteria was that electronic pocketbook media could be used as phytoplankton identification. This criteria received a CVR value of 1.00. Identification can be done through the media by making morphological observations of organisms which included colonies, colony structure, cell shape and size, and physiological observations [43]. Based on the results of validation analysis from 5 validators on the content aspect, the CVR value was 1.00. The content aspect showed valid results because the CVR value exceeds the minimum value [24].

The third aspect was the language aspect which describes the use of language used in electronic pocket book media. The language aspect consisted of three criteria. The first criteria was the suitability of words in sentences with refined spelling (EYD) and this criteria gets a CVR value of 1.00. The writing of words in the media was in accordance with refined spelling (EYD) including standard words, foreign terms, and scientific names. The use of good standard words is in accordance with EYD and KBBI rules [44]. The use of foreign terms can affect the effectiveness of language [45]. The use of appropriate scientific names can provide knowledge and mastery for students [46]. The second criteria was the suitability of sentence writing in electronic pocketbooks with good and correct grammar guidelines which also obtained a CVR value of 1.00. The sentences used in the electronic pocket book were in accordance with good and correct Indonesian. Good Indonesian was in accordance with the applicable Indonesian grammar rules [47]. In addition, language standards in the media included the use of good and correct Indonesian and in accordance with EYD [48]. The third criteria was the clarity and accuracy of the use of high school level language in electronic pocket books. This criteria obtained a CVR value of 1.00. The used of language contained in the electronic pocket book was in accordance with the level of Senior High School or equivalent. Language that was easy to understand was straightforward language and formal everyday language so that students understand according to their level of education, besided that one of the language standards in the media was the clarity of the language used and the ease of reading and understanding by students or readers [32, 48]. Based on the results of the validation analysis from five validators on the language aspect, the CVR value was 1.00. The language aspect showed valid results because the CVR value exceeds the minimum value [24].

The fourth aspect was the practicality aspect related to the function of using the media that describes the used of electronic pocketbook media in the learning process. The format aspect consisted of four criteria. The first criteria was the suitability of using electronic pocket book media both for individuals, as well as groups or classes. This criteria obtained a CVR value of 1.00. Electronic pocketbooks can be used effectively in a variety of student forms. The learning process was basically done individually or in groups. Teachers must consider the learning media used to convey information in bulk, large/small groups or individuals in the learning process so that the media used can be more effective for the diversity of student forms [49,50]. The second criteria was the ease of accessing and using electronic pocketbook media which also obtained a CVR value of 1.00. Electronic pocketbooks can be easily used on various electronic devices (smartphones/laptops/computers/tablets). As

according to Pratiwi and Meilani (2018), one of the indicators supporting the used of media in learning was ease of operation [26]. The third criteria was that electronic pocketbooks could be used online or offline with a file size <50 Mb and get a CVR value of 1.00. Electronic pocketbooks can be used online by using links that can be accessed easily and offline by sharing pdf files so that it can make it easier for students/readers to used the media even though they were constrained by the internet network. The digital media used can make it easier for readers to read without space and time constraints effectively and efficiently [25]. In addition, along with technological developments, students were more likely to like the used of gadgets in learning [51]. The media has met the needs of 21st century learning technology demands that require technology in learning. The fourth criteria was that the electronic pocketbook media can be used repeatedly as long as the file does not error. This criteria received a CVR value of 1.00. Electronic pocketbooks can be used repeatedly anywhere and anytime without being limited by space and time. The advantage of using multimedia in learning was that it can be used repeatedly and can also be used in various situations and was durable [38], [52]. Based on the results of the validation analysis from five validators on the practicality aspect, the CVR value was 1.00. The practicality aspect showed valid results because the CVR value exceeds the minimum value [24].

The results of the validity assessment of the Electronic Pocketbook as a whole get a CVR and CVI value of 1.00. Thats means the media can be said to be valid and feasible to used as learning media for plant-like protists (Phytoplankton) class X Senior High School. Previous research showed printed pocket books also were considered worthy of being a learning medium, but printed pocket books hade weaknesses, namely they were easily lost and easily damaged because they still used paper, so they required expensive production costs to print books [53]. This problem can be overcome by developing technology-based media, namely Electronic Pocket Books that can be used anytime and anywhere without any limitations of space and time. The development of Electronic Pocketbook media was expected to help students understand learning materials and enrich student knowledge and was expected to improve student skills in observing factual materials. However, the impact of pocket book media on student learning outcomes must be proven by conducting tests in the learning process to determine the extent of the media's influence on student learning outcomes.

4. CONCLUSION

The development of the Electronic Pocket Book media for teaching plant-like protists (Phytoplankton) was successfully completed in three stages: pre-production, production, and post-production. The validity assessment of the electronic pocketbook media, based on Content Validity Ratio (CVR) and Content Validity Index (CVI) values of 1.00, indicates that the media is valid and feasible for use in Class X Senior High School as a learning tool. However, further research is required to assess its effectiveness in enhancing the learning process for students in this context.

While the development and validation of the Electronic Pocket Book show promising results, the next logical step is to evaluate its actual impact on students' learning outcomes. Implementing this media in real classroom settings and conducting studies on its effectiveness could provide valuable insights into its ability to improve comprehension, engagement, and retention of complex topics like plant-like protists. If proven effective, this electronic media could serve as a valuable resource for modernizing biology education, especially in promoting interactive and digital learning environments. In the broader context, this research opens opportunities for educators to integrate more technology-based learning tools that cater to diverse learning styles, fostering a more dynamic and student-centered approach. Further development of such tools could be expanded to other subjects, creating a more comprehensive and innovative educational framework in Senior High Schools.

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