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Scientific literacy-based encyclopedia on the antiaging properties of acehnese spices: A research and development approach

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ABSTRACT

The aim of this research is to produce an encyclopedia of Acehnese spice plants that serves as an anti-aging agent developed based on scientific literacy. The encyclopedia of Acehnese spice plants will be used as one of the learning media in the Ethnobotany course. The development procedure was carried out using the ADDIE method which includes analyzing student needs and characteristics, formulating learning objectives, formulating material items, preparing evaluation instruments, writing drafts of encyclopedia, expert validation, field trials, and printing production scripts. Ethnobotanical experts conducted expert validation. The results of the expert validation test stated that the encyclopedia of Acehnese spice plants with antiaging potential as a learning resource to improve student science literacy in ethnobotany courses followed the design and the material included in it was suitable for use as learning media. The field trial results showed that the science literacy-based encyclopedia was very attractive in design and effectively used as learning media.

Keywords: Antiaging, encyclopedia, ethnobotany, science literacy, spice plant

INTRODUCTION

Indonesia is one of the five largest producers of spices in the world (Gustrinazul et al., 2023; Saputro & Anggrasari, 2021). Due to a lack of information and public understanding of their utilization, spices are generally only used as food seasonings. Indonesians face difficulties in recognizing or utilizing existing spices. In this modern era, everything is instantaneous, which makes the next generation unaware of the potential of Indonesian spices. It needs to be introduced to maintain Indonesia's wealth (Fadhlika & Nisa, 2023). The research results show the characteristics of fruit spices (vanilla, cloves, pepper), bark (cinnamon), rhizomes (ginger, turmeric), flowers (saffron), and leaves (bay leaves), while the chemical components of these 8 spices are very complex. Antioxidant compounds, flavonoids, and other active ingredients. The utilization and processing of spices in the cosmetic sector include saffron (facial toner products), cinnamon (anti-acne mask products), turmeric (body lotion products), and black pepper (anti-aging serum products) (Hastuti & Lestari, 2021). The potential of traditional spices is one of the many local wisdoms owned by various regions in Indonesia. One of them is the province of Nanggroe Aceh Darussalam. Nanggroe Aceh Darussalam is a province in the far west of Indonesia. Spices have long been known and used by the people there as food seasonings and traditional medicines (Djunaidy, 2022; Sutrisno et al., 2020). Some of their utilization as raw materials for beauty cosmetic products has even developed today (Ervilita & Mardhiah, 2022; Novitasari et al., 2024).

The encyclopedia of plant utilization can be a good learning resource in supporting education (Aini et al., 2024; Fadhilah et al., 2022; Julianti et al., 2021; Nurmasari et al., 2021). Learning resources are defined as something available in the learning environment that functions to assist the learning process for both lecturers and students (Aljawarneh, 2020; Munna & Kalam, 2021). Learning resources consist of materials that are utilized and needed in the learning process such as encyclopedias, textbooks, print media, electronic media, sources, and the surrounding environment that can increase student activeness in the learning process (Muchira et al., 2023; Palamar et al., 2021). One of the learning resources that teachers and students often use is textbooks. Textbooks usually have long read descriptions causing low student interest in reading (Furenes et al., 2021; Lim et al., 2021).

An encyclopedia is a very complex reference work that combines a wide range of information about a field of knowledge (Laihonen et al., 2024; Marans et al., 2024). Encyclopedias were usually organized alphabetically or by theme (Holmberg, 2021). Encyclopedia books have the advantage of being systematic and continuous, which means that the content is organized coherently and can be used as ongoing research material (Melgaard et al., 2022; Turner et al., 2023). In addition, encyclopedias are interesting and can help students in the learning process. The introduction of various species can be included in the encyclopedia. The encyclopedia was chosen because it is accompanied by pictures, which makes it look concise, interesting, and light to learn. Currently, there are many sources of information that we can use, one example is an encyclopedia that contains various information about spice plants. Encyclopedias can be used as additional learning resources in the introduction of species, particularly in their application as local wisdom in a region. For example, the introduction of spice plants, which are commonly used as cooking ingredients, can actually be utilized as raw materials in cosmetics as an anti-aging source.

The development of this ethnobotany encyclopedia as a learning medium for ethnobotanical lectures is due to the need for science literacy-based learning media. This needs to be developed because science literacy in Indonesia is considered low. According to the results of the 2023 PISA survey, the average science literacy in Indonesia is still considered low compared to other countries. A study conducted in 2022 showed that Indonesia's average science literacy score was 383 (Schleicher, 2023), while in 2018 it was 396. There has been a decline in science literacy skills in Indonesia compared to the global science literacy score, which reached 500 (OECD, 2019). One of the factors for the low science literacy of students was the low interest and motivation of students to learn science (Hariyadi et al., 2023). The presence of science literacy in a student will bring students into a society that was able to master science material, understand the characteristics of science, and be able to apply science concepts in real life. Science literacy was very important to be mastered by students because it relates to how students can recognize the environment through the process of science (Sukmawati & Zulherman, 2023; Sutiani et al., 2021). Development of encyclopedia based science literacy can enhance students' science literacy skills (Agustiani et al., 2024). But not much development research has been done on the creation of an encyclopedia of spice plants.

PISA (Program for International Student Assessment) suggests that science literacy is the ability to use science skills, identify questions, and draw conclusions based on evidence to understand the characteristics of science as scientific inquiry, awareness of how science and technology shape material, intellectual and cultural circles, and the desire to engage in science-related issues as reflective human beings (Hartono et al., 2022; Kelp et al., 2023). Science literacy is also defined as students' current knowledge, values, and abilities linked to

future needs (Almeida et al., 2023; Wen et al., 2020).

The objective of this development research is to produce an encyclopedia of Acehnese spice plants that have antiaging activities, based on science literacy in ethnobotany courses as one of the learning media, which can add to the data base about Aceh spice plants that play a role as antiaging and improve the science literacy of students who study ethnobotany through this encyclopedia.

The research presents novel aspects in its encyclopedia documentation of Acehnese spices for anti-aging that integrates ethnobotany with science literacy. This innovation manifests in three key aspects: (1) the first systematic documentation of Acehnese spices' anti-aging potential, previously known only as cooking ingredients, (2) development of a learning medium that combines local wisdom with PISA science literacy standards, addressing Indonesia's low science literacy score (383 in 2023), and (3) establishment of a comprehensive database on Acehnese spices with potential for local cosmetic industry development. This unprecedented approach offers solutions for both educational challenges and traditional knowledge preservation.

METHOD

The research method used is research and development (Febrianti et al., 2024). The development carried out is in the form of making a science literacy-based encyclopedia of Acehnese spice plants that have antiaging activities, in the ethnobotany course. The encyclopedia developed can be used by students themselves or with the guidance of lecturers. The evaluation subjects consisted of the material expert test, a design expert test, a small group test, and an effectiveness test. The material expert test was conducted by content experts to evaluate the content of learning materials in the science literacy-based encyclopedia, and the expert test was conducted by design experts to evaluate the design of the science literacy-based encyclopedia (Ramly et al., 2022). Using simple random sampling techniques, 10 students were selected as a small group to determine the level of attractiveness and usefulness of the encyclopedia created. Furthermore, using purposive sampling techniques, 30 students were selected as a limited group to the effectiveness test was carried out on students of the Ethnobotany Biology Program, Faculty of Mathematics and Natural Sciences, State Universitas Negeri Medan, which aims to determine the effectiveness of encyclopedias in learning.

The ADDIE development model was chosen because it can make it easier for educators and training instructors to design any type of curriculum, regardless of the learning method used where this development model focuses on reflection and literation (Febrianti et al., 2024). This development research used adapted development research methods from ADDIE which contains development research steps that aim to produce products. This development model includes eight procedures including: (1) analyzing the needs and characteristics of students, (2) formulating learning objectives, (3) formulating material items, (4) preparing evaluation instruments, (5) writing media drafts, (6) conducting expert validation (7) conducting trials and revisions, (8) printing production scripts (Kartini et al., 2024; Sufyan et al., 2024).

Data in this development research was obtained through a needs analysis survey, questionnaire instruments, observation sheets, and tests. The needs analysis survey was used to obtain information about the needs of students in the learning process. The questionnaire instrument was used in the expert validation test to collect data on the feasibility of the product based on the content of the material and the suitability of the design made. The observation sheet is used in the field trial to collect the attractiveness and usefulness of the product. The last stage of this research is a written test for students which is used to collect data on the level

of product effectiveness in learning (Arifiyyati et al., 2023; Pasaribu et al., 2024).

The needs analysis data obtained from lecturers and students is used to compile the background and level of need for development products. Data on the suitability of design and material in the developed product is obtained from material experts and design experts through expert validation tests. The suitability data is to determine the feasibility level of the product produced and used as learning media. Data on product attractiveness and product usefulness were obtained from field evaluations to students directly. Meanwhile, learning outcome data is obtained through tests after using the product to determine whether the developed product has been effectively used as a learning media (Ayuningtyas et al., 2024; Mardiati et al., 2023). The product is declared effective as a learning medium if 70% of the students in the class score above 70 based on the results of the posttest that has been given.

Data on product attractiveness was obtained from students at the field trial stage. The observation sheet has 4 answer options that match the question content, namely: "not interesting", 'quite interesting', 'interesting', and 'very interesting'. Then the observation sheet to obtain data on the usefulness of the product has 4 answer choices, namely: "not useful", "quite useful", "useful", and "very useful". Each of the answer choices has a different score (Ayuningtyas et al., 2024; Lastri et al., 2024; Sukmawati & Zulherman, 2023).

RESULTS AND DISCUSSION

The main result of the development research that has been conducted at the Department of Biology Mathematics and Natural Sciences Faculty; Universitas Negeri Medan is a science literacy-based encyclopedia to educate ethnobotanical concepts related to Acehnese spice plants that function as antiaging ingredients. The detailed results of each stage of the development procedure carried out are as follows:

Needs analysis and student characteristics

Needs analysis is an activity carried out to determine the needs of students, lecturers, and universities. In this development research, the needs analysis was carried out by randomly distributing a needs analysis questionnaire to 20 students of the biology study program, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan. The questionnaire consists of 13 open and closed-ended questions related to the media and learning resources used as well as their application in teaching the Ethnobotany course, including: a. What learning resources or media do you, the lecturer, use in teaching the Ethnobotany course? b. What the topic of Medicine and Cosmetics very interesting to study in the Ethnobotany course? c. What kind of learning resources are interesting to use in studying the material on Medicinal and Cosmetic Plants? d. Have you ever used an Encyclopedia as a learning resource in the ethnobotany course? e. In your opinion, what is an Encyclopedia suitable as a learning resource for the Ethnobotany course? Why is that? The results of the needs analysis questionnaire that has been conducted to students' state that 62% of students prefer encyclopedias with concise writing and picture explanations then lecturers more often use them in student worksheets. Lecturers have never used encyclopedias in learning in this course, therefore it is necessary to develop a science literacy-based ethnobotanical encyclopedia to help students in the learning process.

Formulation of material content

At the stage of formulating the content items, what is done first is to identify the final ability of each learning stage (Sub-CPMK) to determine the items to be achieved by making indicator mapping, the Sub-CPMK that is used as the basis can explain the types of plants used by Indonesian ethnic groups as traditional medicine. The indicators used are to explain the types of plants used as ingredients in traditional medicine, identifying types of plants used as

traditional medicine, describing the application of medicinal plants in people's lives and applying ethnobotany in drug production.

a. Preparation of evaluation instruments

The preparation of evaluation instruments is carried out to measure the achievement of learning, whether the objectives are achieved or not. The evaluation instrument that has been made is used to collect data on the level of effectiveness of the product in learning in the form of a written test. 50 multiple-choice questions with 5 answer options based on Sub-Course Learning Outcome (CPMK) and learning indicators are provided. Then, from the 50 questions, validity tests, reliability tests, question difficulty levels, and question discrimination tests are conducted. After these tests, 20 multiple-choice questions are selected, which are considered valid and reliable, with a distribution of 50% easy questions, 30% medium questions, and 20% difficult questions.

b. Writing media draft

The next stage was writing a media draft, this stage is done to create a scenario for the development of a science literacy-based encyclopedia, and after creating a development scenario then proceed with writing a media draft. The activity of writing media draft is the activity of compiling the media or draft media itself. The resulting media script is in the form of a science literacy-based ethnobotanical encyclopedia. At the stage of compiling media draft activities, first, make a page layout. Layout in a book is the layout or arrangement of book elements on one page so that readers feel comfortable reading the page. Layout in this ethnobotanical encyclopedia is divided into two types, namely preface layout and content layout. The preface layout is made more colorful because the content in the preface is short. The layout of the preface contains general informative sentences to attract readers' interest in spice plants as a source of anti-aging, including sections on classification, description, and the utilization of these plants in society. Meanwhile, the layout contains in-depth information about the anti-aging content of spice plants, their processing methods, and their use in daily life. In this section, a barcode or additional information link related to images, videos, or supplementary articles can also be included to enhance the information from an encyclopedia. In some sections, tips and quiz questions are also included to further engage students in reading.

c. Conducting expert validation

After completing the media draft, the next step is to conduct expert validation. Expert validation is carried out to determine the suitability of the material presented with competency standards and the suitability of the design of the product that has been made. There are two activities carried out at this stage, namely: The material expert test is a formative evaluation 1 aimed at evaluating the completeness of the material, the correctness of the material, the systematics of the material, and various things related to the material such as examples and phenomena in everyday life and the development of appropriate exercise questions. The evaluators chosen were experts in the fields of ethnobotany and phytochemistry. The test results on each aspect assessed in this material expert test can be seen in Table 1.

Table 1. Material expert test results

No	Aspect of assessment	Recommendations for Improvement	Results of Improvement
1	The suitability of the material presented is current (up to date), that is, with the latest scientific developments	Need to add materials that refer to the latest technology.	Some materials have been added to the encyclopedia created
2	The relevance of the examples presented reflects those presented reflect current events occurrences, or conditions (up to date)	Need to be presented more realistically in current conditions.	Some relevant examples have been added.

No	Aspect of assessment	Recommendations for Improvement	Results of Improvement
3	The sensitivity of the presentation of material descriptions (stories, problems, or phenomena) stimulates students to think further.	Need to be clarified to be more systematic.	The material made has been presented more systematically.
4	Learners' efficiency in obtaining information from various sources.	The encyclopedia book does not include information from various sources.	In each picture and bibliography, the source of information has been presented
5	Clarity of language used for concepts and illustrations, describing concrete examples (which are often encountered by students) to abstract examples (which are imaginative).	Use good and correct language.	Incorrect grammar has been corrected.
6	The level of reinforcement of understanding of the principles between the material and the examples of phenomena displayed.	Need to clarify the phenomenon.	The material has been improved with examples of phenomena.

Furthermore, the learning media design expert test is a formative evaluation that aims to determine the accuracy of the minimum standards applied in the preparation of the encyclopedia and to determine the attractiveness and visual effectiveness of students or users of the encyclopedia. The evaluator chosen is a design expert. The test results on each aspect assessed in this design expert test can be seen in Table 2.

Table 2. Design expert test results

No	Assessment aspect	Improvement Recommen-dation	Improvement Result
1	Image illustration suitability with the content of the learning message	The image illustration size is inconsistent	The size of the illustration has been consistent with the content of the learning message
2	Neatness of the developed learning encyclopedia	It is better if the position between the picture and the writing is paid attention to.	The position between the picture and the writing has been improved.

d. Conducting trial and revision

The trial and revision stage were conducted in one class of ethnobotany course randomly in the biology study program of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan. The trial was conducted twice, the first being the small group test and the effectiveness test. The first trial was the small group test. In the small group test, there were 10 students involved. In the small group test, students were divided into three groups, namely 4 students with different levels of learning outcomes are high abilities, 3 students with medium abilities, and 3 students with low abilities. The purpose of grouping students is to find out student responses to the encyclopedia developed from different student abilities. Students were divided into several groups, then students were given a questionnaire on the interestingness and usefulness of the product. The results of the small group test can be read in Table 3 and Table 4.

Table 3. Results of the interestingness test

No	Student Ability	Average Score	Percentage of Attractive-ness	Qualitative Statement
1	High	3.6	90	Excellent
2	Medium	3.51	87.75	Excellent
3	Low	3.56	89	Excellent

Table 4. Expediency test results

No	Student Ability	Average Score	Percentage of Attractive-ness	Qualitative Statement
1	High	3.7	92.50	Excellent
2	Medium	3.63	90.75	Excellent
3	Low	3.8	95	Excellent

From Table 3, the student responses for the interestingness of the encyclopedia are not much different. After being converted to qualitative statements, it was found that the

results of this small group test stated that the science literacy-based ethnobotanical encyclopedia used was very attractive in design.

From Table 4, the student responses for the usefulness of the encyclopedia book are not much different. After being converted to Qualitative statements, it was found that the results of this small group test stated that the science literacy-based ethnobotanical encyclopedia used was very useful for students in understanding ethnobotanical material. The second trial, namely the effectiveness test.

The effectiveness test was carried out by giving 20 multiple-choice questions under the learning objectives that had been made and the material contained in the ethnobotanical encyclopedia. Test instrument blueprints can be seen as Table 5.

Table 5. Test instrument blueprint

Test Instrument Component	Indicator	Cognitive Knowledge						Total
		C1	C2	C3	C4	C5	C6	
Concept and Understanding of Spice Plants	Knowledge and basics of ethnobotany and spice plants	1	-	-	2	3		3
	Benefits of spice plants	-	4,5,9,10	6,8	7,11	-	-	8
	Identification of spice plants	-	12	13	14,15	-	-	4
	How to use spices	-	16	17,18	-	-	-	3
	Organs of plant used	-	19	20	-	-	-	2
Total		**1**	**7**	**6**	**5**	**1**	**0**	**20**

The results of the effectiveness trial obtained the average post-test value of students is 73.66. In the method, it has been explained that if 75% of ethnobotany scores are above 70 then the media is said to be effective. Based on the results of the learning effectiveness test, the developed science literacy-based encyclopedia is effective and can be used as one of the learning media for ethnobotany courses.

e. Printing the production manuscript

Based on the results of the trial and revision, improvements and refinements to the encyclopedia were made, after improvements were made, the final product of the development was obtained in the form of an ethnobotanical encyclopedia related to Acehnese spice plants that function as antiaging agents as science literacy-based learning media.

This development produces a product in the form of a science learning encyclopedia with the following product specifications: 1) Dimensions: 17.6 x 25 cm; 2) Paper type: HVS 80 gr; 3) Number of pages: 227 pages; 4) Main font type: Comic Sans MS; and 5) Font size: 9 pt.

All encyclopedia components are made in full color. This is done to increase the attractiveness of the developed ethnobiology encyclopedia. The developed product can be seen in Figure 1.

In the encyclopedia development product, there is: cover is the outermost part of the encyclopedia developed which contains the title, author, and material to be presented (Sari et al., 2024). The Foreword is an introduction given by the author before encyclopedia users start utilizing this encyclopedia. The table of contents is used to make it easier for readers to find the page to be read. The description of the material is an explanation and description of the material presented in this encyclopedia. This encyclopedia consists of 227 pages. The material presented is ethnobotanical material related to Acehnese spice plants that function as antiaging ingredients based on science literacy where science literacy is applying material in everyday life adapted to the material to be discussed. Each end of chapter ends with an evaluation in the form of multiple-choice exercises and essay questions. Exercise questions consist of 10 questions, namely 5 multi-choice questions and 5 essay questions. Some of the evaluation test questions contain illustrations.

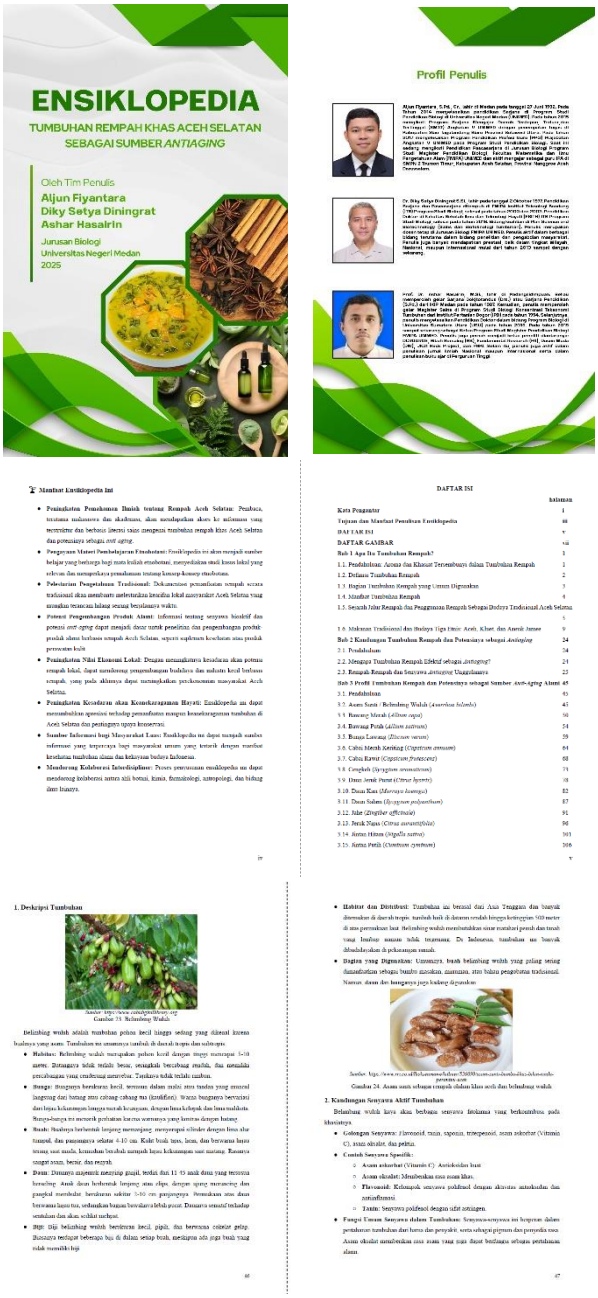

Figure 2. Ethnobotanical encyclopedia of development products

The suitability of the product produced with the development objectives. The purpose of this development research is to produce an ethnobotanical encyclopedia related to Acehnese spice plants that function as antiaging agents, based on science literacy that can be used as student learning media. The final product of this development research is an ethnobotanical encyclopedia related to Acehnese spice plants that have the potential as antiaging agents, based on science literacy.

The description of the material presented is made concise, equipped with illustrative images, full color, and based on science literacy. After studying this book, students are expected to be able to use their science skills to identify questions and draw conclusions based on evidence to understand and make decisions regarding nature. The material contained in this encyclopedia is a reinforcement of the material that has been given by lecturers in class. After going through the expert validation test, a field trial was conducted.

Based on the results of the small group test of the developed science literacy-based ethnobotanical encyclopedia, the value of the level of interest is 3.6 and the value of the level of usefulness is 3.7. Based on the criteria for the final assessment of the interestingness and usefulness test on the method, this ethnobotanical encyclopedia based on science literacy is included in the very good criteria. The effectiveness of this science literacy-based ethnobotanical encyclopedia can be seen from the number of students who obtained scores above 70 reached 84.21% or 31 students out of 36 students.

Previous research by Zaimah et al (2022) has developed an ethnomedicine encyclopedia as a learning resource. The encyclopedia developed is a reinforcement of the material that has been given on campus. Likewise, this encyclopedia is used as one of the additional textbooks from the main textbooks such as package books. Therefore, with the various textbooks developed, it can be an additional textbook and when used by students, students get even more knowledge (Hariyadi et al., 2023; Zaimah et al., 2022).

According to Sri encyclopedia book based on scientific literacy has been assessed as good by material experts with a validation percentage of 72%, very good by media experts with a percentage of 86%, and very good also by learning experts with a percentage of 94% (Agustiani et al., 2024). The encyclopedia of medicinal plants has been adjusted to basic competencies, consisting of images derived from

research photographs in hardcopy form. This provides explanations about the morphological classification and benefits of the plants, as well as instructions on how to use the media. This will help students learn independently with this media. The encyclopedia of medicinal plants is very suitable for use as a medium in high schools because it is very valid and easy for students to understand. In addition, it enhances affective, cognitive, and psychomotor learning outcomes (Hadiati et al., 2022). According to Azizah based on the research results, it can be concluded that the developed e-encyclopedia is suitable to be used as a supplementary teaching material in the X MIPA 3 class based on the average validation score of material experts of 85.41% and the average validation score of media of 84.57%, with the criteria of very feasible. The E-encyclopedia teaching material is effective in improving the digital literacy of X MIPA 3 students. This was evidenced by the posttest results in the form of a questionnaire given to students, with a percentage of 81.05% categorized as very high. Based on the teacher and student questionnaires, 92.30% received an evaluation from the student questionnaire results of 89.63%, indicating that statements 3 and 12 had the highest response scores, namely 92.85% (Azizah et al., 2021).

Based on these results, it can be stated that the science literacy-based ethnobotanical encyclopedia is effectively used as one of the learning media. This is because by using various learning resources such as encyclopedias, students could better understand the concept of ethnobotanical learning and take part in learning is very good, so the Science Literacy-Based Ethnobotanical Encyclopedia developed is effective and interesting to be used as a student learning media.

The advantages of the development product are as follows. The development product in the form of a science literacy-based ethnobotanical encyclopedia has several advantages, namely: (a) This encyclopedia is B5 UNESCO size so it is easy to carry anywhere with a short reading description and students can learn it anywhere, (b) The developed encyclopedia is made in full color so that it makes students more interested in reading and learning it, (c) Being a variety of learning resources besides student worksheets which have been often used on campus before.

The weaknesses of this development product are as follows the development product in the form of a science literacy-based ethnobotanical encyclopedia has several weaknesses, namely (a) it costs more money to print this encyclopedia because of its full-color presentation, (b) not all students like encyclopedias that are small in size and visual media, this depends on the type of student learning, (c) the material in this encyclopedia is still small compared to the entire ethnobotany in a semester course.

CONCLUSION

Based on the results and discussion, it can be concluded as follows: (a) Acehnese spice plant encyclopedia that functions as an antiaging agent as a science literacy-based learning media that has been tested and is feasible to use, (b) Acehnese spice plant encyclopedia that functions as an antiaging agent based on science literacy produced is tested effective to be used as a learning media based on the results of field trials conducted on Biology students FMIPA UNIMED declared effective with a percentage of student learning completeness of 84.21%.

Suggestions from this development research are: (a) Teaching ethnobotany should not only use one learning resource but can use the science literacy-based ethnobotany encyclopedia that has been developed by the author so that it can help students to better understand the concept of ethnobotany. (b) Lecturers should be more creative in modifying teaching materials that are already available so that learning is not monotonous. (c) It is hoped that future researchers can develop this encyclopedia with a different design from the existing one.

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REFERENCES

Agustiani, S., Idramsa, I., & Djulia, E. (2024). Development of A Biotechnology Encyclopedia Based on Scientific Literacy to Improve Students' Scientific Literacy Abilities Unimed Biology Education Program. *Eduvest-Journal of Universal Studies*, *4*(10), 9363–9374. https://doi.org/10.59188/eduvest.v4i10.1365

Aini, S., Setiadi, A. E., & Sunandar, A. (2024). Development of encyclopedia based on local vegetables North Kayong Regency as biology learning media. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *10*(1), 38–46. https://doi.org/10.22219/jpbi.v10i1.31557

Aljawarneh, S. A. (2020). Reviewing and exploring innovative ubiquitous learning tools in higher education. *Journal of Computing in Higher Education*, *32*(1), 57–73. https://doi.org/10.1007/s12528-019-09207-0

Almeida, B., Santos, M., & Justi, R. (2023). Aspects and abilities of science literacy in the context of nature of science teaching. *Science & Education*, *32*(3), 567–587. https://doi.org/10.1007/s11191-022-00324-4

Arifiyyati, M. F., Rofi'ah, N. L., & Listyono, L. (2023). Correlation between scientific literacy with higher order thinking skills and self-efficacy in biology learning. *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi Dan Biologi*, *5*(2), 166–176. http://dx.doi.org/10.30821/biolokus.v5i2.1633

Ayuningtyas, D., Kuswandi, P. C., & Rahmawati, R. (2024). Needs analysis of local potential pteridophyta E-encyclopedia-based for high school. *AIP Conference Proceedings*, *2622*(1). https://doi.org/10.1063/5.0133542

Azizah, Y. N., Lathifah, S. S., & Hidayat, N. (2021). Pengembangan E-ensiklopedia Keanekaragaman Talas di Kabupaten Bogor Berbasis ESD untuk Meningkatkan Literasi Digital Siswa. *Pedagogia: Jurnal Ilmiah Pendidikan*, *13*(2), 52–56. https://doi.org/10.55215/pedagogia.v13i2.4247

Djunaidy, D. (2022). Land Management and Economic Improvement of Pala Plantations In The Banda Island After Colonialization 1954-2018. *Erudio Journal of Educational Innovation*, *9*(2), 256–268. https://doi.org/10.5281/zenodo.8081427

Ervilita, R., & Mardhiah, A. (2022). Local Wisdom of the Aceh Jaya Society in terms of Indigenous Cuisine that can be learned in Chemistry Learning in Schools. *Proceedings of International Conference on Multidiciplinary Research*, *5*(1), 134–146. https://doi.org/10.32672/pic-mr.v5i1.5265

Fadhilah, R., Auliaty, Y., & Wardhani, P. A. (2022). Pengembangan Ensiklopedia Digital Tanaman Hias Berbasis Kontekstual Sebagai Sumber Belajar Dalam Pembelajaran IPA Kelas IV SD. *Educational Technology Journal*, *2*(2), 29–37. https://doi.org/10.26740/etj.v2n2.p29-37

Fadhlika, P. D., & Nisa, D. A. (2023). Upaya Pengenalan Rempah-Rempah Indonesia Pada Anak Usia 7-10 Tahun Melalui Board Game Edukatif. *Jurnal Nawala Visual*, *5*(2), 85–93. https://doi.org/10.35886/nawalavisual.v5i2.606

Febrianti, A., Sunandar, A., & Qurbaniah, M. (2024). Development of an ethnobotany-based encyclopedia on the use of banana species by the Sambas Malay community. *Research and Development in Education (RaDEn)*, *4*(1), 502–515. https://doi.org/10.22219/raden.v4i1.32998

Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A comparison of children's reading on paper versus screen: A meta-analysis. *Review of Educational Research*, *91*(4), 483–517. https://doi.org/10.3102/0034654321998074

Gustrinazul, Hadi, S., Restuhadi, F., & Lukmanasari, P. (2023). Export Competitiveness Analysis of Pepper (Piper Nigrum L) Commodity in the International Market. *Jurnal Agrinika: Jurnal Agroteknologi Dan Agribisnis*, *7*(2), 134–143. https://doi.org/10.30737/AGRINIKA.V7I2.4773

Hadiati, D., Retnoningsih, A., & Widiatningrum, T. (2022). Development of Medicinal Plants Ethnobotany Study-Based Encyclopedia as Plantae Study Media. *Journal of Innovative Science Education*, *11*(1), 7–15. https://doi.org/10.15294/jise.v10i1.46127

Hariyadi, S., Rofiâ, A., Santosa, T. A., & Sakti, B. P. (2023). Effectiveness of STEM-based mind mapping learning model to improve students' science literacy in the era of Revolution 4.0. Jurnal Penelitian Pendidikan IPA, 9(10), 791–799. https://doi.org/10.29303/jppipa.v9i10.5125

Hartono, H., Putri, R. I. I., Inderawati, R., & Ariska, M. (2022). The strategy of Science Learning in Curriculum 2013 to Increase the Value of Science's Program for International Student Assessment (PISA). *Jurnal Penelitian Pendidikan IPA*, *8*(1), 79–85.https://doi.org/10.29303/jppipa.v8i1.1185

Hastuti, A., & Lestari, T.A. (2021). Pemanfaatan 8 jenis rempah dibidang kosmetik, bumbu masak, makanan hingga fragrance dan flavour. *Jurnal Ilmiah Pangan Halal*, *3*(1), 9–18.

Holmberg, L. (2021). Stranded Encyclopedias in Eighteenth-Century Sweden: Exploring the Rise of Alphabetical Encyclopedism. *Stranded Encyclopedias, 1700–2000: Exploring Unfinished, Unpublished, Unsuccessful Encyclopedic Projects*, 99–135. https://doi.org/10.1007/978-3-030-64300-3_4

Julianti, R., Asra, R., & Yelianti, U. (2021). Pengembangan Ensiklopedia Tumbuhan Obat Masyarakat Kerinci Sebagai Sumber Belajar Materi Keanekaragaman Hayati Untuk Siswa SMA. *Biodik*, *7*(01), 13–22. https://doi.org/10.22437/bio.v7i01.11314

Kartini, A., Husamah, H., Permana, F. H., & bin Mohd Shukri, A. A. (2024). PBL-based STEM: Its effect on the cognitive learning outcome of junior high school students. *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi Dan Biologi*, *6*(2), 187–195. http://dx.doi.org/10.30821/biolokus.v6i2.2673

Kelp, N. C., McCartney, M., Sarvary, M. A., Shaffer, J. F., & Wolyniak, M. J. (2023). Developing science literacy in students and society: Theory, research, and practice. *Journal of microbiology & biology education*, *24*(2), e00058-23), 1–4. https://doi.org/10.1128/jmbe.00058-23

Laihonen, H., Kork, A.-A., & Sinervo, L.-M. (2024). Advancing public sector knowledge management: towards an understanding of knowledge formation in public administration. *Knowledge Management Research & Practice*, *22*(3), 223–233. https://doi.org/10.1080/14778238.2023.2187719

Lastri, S., Niswaty, R., & Arhas, S. H. (2024). Analysis of the Utilization of Office Administration Learning Media. *Journal of Educational Development and Learning (JEDAL)*, *1*(1), 34–40. https://doi.org/10.70188/ngrban76

Lim, J., Whitehead, G. E. K., & Choi, Y. (2021). Interactive e-book reading vs. paper-based reading: Comparing the effects of different mediums on middle school students' reading comprehension. *System*, *97*, 102434. https://doi.org/10.1016/j.system.2020.102434

Marans, R. W., Gerber, E. R., & Morenoff, J. D. (2024). Detroit area studies (DAS). In *Encyclopedia of Quality of Life and Well-Being Research*. Springer.

Mardiati, Y., Herlanti, Y., & Qodriyah, A. L. (2023). Student argumentation skills' analysis on the discussion of socio-scientific issues in the concept of viruses. *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi Dan Biologi*, *5*(2), 150–159. http://dx.doi.org/10.30821/biolokus.v5i2.1945

Melgaard, S. P., Andersen, K. H., Marszal-Pomianowska, A., Jensen, R. L., & Heiselberg, P. K. (2022). *Fault Detection and Diagnosis Encyclopedia for Building Systems: A Systematic Review. Energies 2022,* *15*(12), 4366, 1–50. https://doi.org/10.3390/en15124366

Muchira, J. M., Morris, R. J., Wawire, B. A., & Oh, C. (2023). Implementing competency based curriculum (CBC) in Kenya: challenges and lessons from South Korea and USA. *Journal of Education and Learning*, 12(3), 62–77. https://doi.org/10.5539/jel.v12n3p62

Munna, A. S., & Kalam, M. A. (2021). Teaching and learning process to enhance teaching effectiveness: a literature review. *International Journal of Humanities and Innovation (IJHI)*, *4*(1), 1–4. https://doi.org/10.33750/ijhi.v4i1.102

Novitasari, Y., Hardiany, L., Husaini, I. P. A., & Hariri, M. R. (2024). Plant Collections of Bogor Botanical Gardens: Potential for Cosmetics (Skincare) and Their Conservation Status. *Philippine Journal of Science*, *153*(3), 1203–1215. https://doi.org/10.56899/153.03.37

Nurmasari, Besse Tenriawaru, A., & Syamswisna. (2021). Kelayakan Ensiklopedia Pada Submateri Pemanfaatan Keanekaragaman Hayati Dari Hasil Etnobotani Tumbuhan Obat Feasibility of Encyclopedia on Use of Biodiversity Sub-Matter From the Ethnobotany of Medicinal Plants. *Jurnal Penelitian Pendidikan Biologi*, *5*(2), 85–92. https://doi.org/10.32502/dikbio.v5i2.4438

OECD. (2019). *An OECD Learning Framework 2030.* The Future of Education and Labor.

Palamar, S. P., Bielienka, G. V, Ponomarenko, T. O., Kozak, L. V, Nezhyva, L., & Voznyak, A. V. (2021). Formation of readiness of future teachers to use augmented reality in the educational process of preschool and primary education. *Proceedings of the 4th International Workshop on Augmented Reality in Education (AREdu 2021) Kryvyi Rih, Ukraine, May 11, 2021, 2898*, 334–350. http://ceur-ws.org/Vol-2898/paper18.pdf

Pasaribu, E. C., Candramila, W., & Mardiyyaningsih, A. N. (2024). Development of encyclopedia in biology "Growth and Development" enriched with an information of stunting. *Jurnal Mangifera Edu*, *9*(1), 1–12. https://doi.org/10.31943/mangiferaedu.v9i1.189

Ramly, S. N. F., Ahmad, N. J., & Said, H. M. (2022). The development of innovation and chemical entrepreneurship module for pre-university students: An analysis phase of ADDIE model. *Journal of Natural Science and Integration*, *5*(1), 96–116. http://dx.doi.org/10.24014/jnsi.v5i1.16751

Saputro, W. A., & Anggrasari, H. (2021). The Role, Development And Opportunities Of Spice Commodities For International Relations Between Indonesia And Other Countries In The International Market. *Jassp*, *1*(2), 154–166. https://doi.org/10.23960/jassp.v1i2.34

Sari, M. M., Yulindaa, R., Oktaviania, R., & Hidayatia, Noor Niki Mawartia, M. (2024). *Validitas ensiklopedia flora di pulau curiak barito kuala*. *9*(April), 127–134.

Schleicher, A. (2023). Programme for International Student Assessment (PISA) 2022 : Insights and Interpretations. *OECD 2023*, 1–72.

Sufyan, Q. A., Wahidmurni, W., & Astuti, R. N. (2024). Development of an Encyclopedia Based on the Integration of Islam and Science to Improve Understanding of the

Motion System in Humans for Grade V Students of SDIT Al-Irsyad Pamekasan. *MANAZHIM*, *6*(2), 578–602. https://doi.org/10.36088/manazhim.v6i2.5279

Sukmawati, W., & Zulherman, Z. (2023). Analysis of Changes in Students' Scientific Literacy Ability After Attending Lectures Using the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1039–1044. https://doi.org/10.29303/jppipa.v9i3.2846

Sutiani, A., Situmorang, M., & Silalahi, A. (2021). Implementation of an inquiry learning model with science literacy to improve student critical thinking skills. *International Journal of Instruction*, *14*(2), 117–138. https://doi.org/10.29333/iji.2021.1428a

Sutrisno, I. H., Akob, B., Navia, Z. I., Nuraini, N., & Suwardi, A. B. (2020). Documentation of ritual plants used among the Aceh tribe in Peureulak, East Aceh District, Indonesia. *Biodiversitas Journal of Biological Diversity*, *21*(11), 4990–4998. https://doi.org/10.13057/biodiv/d211102

Turner, J. R., Allen, J., Hawamdeh, S., & Mastanamma, G. (2023). The multifaceted sensemaking theory: a systematic literature review and content analysis on sensemaking. *Systems*, *11*(3), 145, 1–24. https://doi.org/10.3390/systems11030145

Wen, C.-T., Liu, C.-C., Chang, H.-Y., Chang, C.-J., Chang, M.-H., Chiang, S.-H. F., Yang, C.-W., & Hwang, F.-K. (2020). Students' guided inquiry with simulation and its relation to school science achievement and scientific literacy. *Computers & Education*, *149*, 103830. https://doi.org/10.1016/j.compedu.2020.103830

Zaimah, U., Hasairin, A., & Diningrat, D. S. (2022). The Validity of The Encyclopedia Mandailing Ethnomedicine in The Area of Mount Sorik Marapi as a Student Learning Resource. *Proceedings of the 7th Annual International Seminar on Transformative Education and Educational Leadership, AISTEEL 2022, 20 September 2022, Medan, North Sumatera Province, Indonesia: AISTEEL 2022*, 114–124. http://dx.doi.org/10.4108/eai.20-9-2022.2324561