

Handout of Pteridophyta of Sultan Adam Tahura area oriented to critical thinking ability of high school learners

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Article Information	Abstract
Keyword: Handout; Validity; Learner response; Pteridophyta; Critical thinking skills Kata Kunci: Handout; Kevalidan; Respon peserta didik; Pteridophyta; Keterampilan berpikir kritis History: Received : 27/01/2024 Accepted : 29/02/2024	The Industrial Revolution 4.0 era requires every individual to think critically about various real-life problems, but these competencies are less trained in biology learning at school. This study aims to analyze the feasibility of the handout Pteridophyta Kawasan Tahura Sultan Adam oriented critical thinking skills of high school students. This research includes research and development with the 4D model. Data were obtained through validation by 3 experts, responses of 8 students while using the handout on a limited trial, and 25 students on a broad trial. The characteristics of the handout developed compared to other teaching materials are that the teacher can develop it with a free format, practice questions in each sub-chapter of material, conclusion features in each reading, and real pictures that facilitate understanding of the material. The experts agreed that the handout developed had an average validity value of 4.3 with very valid criteria. In addition, students' responses to the Pteridophyta handout in the limited trial and broad trial were very good. Thus, the developed Pteridophyta handout is feasible to train critical thinking skills in biology learning. <i>Abstrak. Era revolusi industri 4.0 menuntut setiap individu mampu berpikir kritis dalam menghadapi berbagai permasalahan kehidupan nyata, namun kompetensi tersebut kurang dilatihkan dalam pembelajaran biologi di sekolah. Penelitian ini bertujuan untuk menganalisis kelayakan handout Pteridophyta Kawasan Tahura Sultan Adam berorientasi kemampuan berpikir kritis peserta didik tingkat SMA. Penelitian ini termasuk penelitian dan pengembangan dengan model 4D. Data diperoleh melalui validasi oleh 3 pakar, respon 8 peserta didik selama menggunakan handout pada uji coba terbatas dan 25 peserta didik pada uji coba luas. Karakteristik handout yang dikembangkan dibandingkan dengan bahan ajar lainnya adalah mampu dikembangkan sendiri oleh guru dengan format bebas, terdapat latihan soal disetiap sub bab materi, fitur kesimpulan disetiap bacaan dan gambar nyata yang mempermudah pemahaman materi. Para pakar sepakat bahwa handout yang dikembangkan memiliki nilai rata-rata validitas sebesar 4,3 dengan kriteria sangat valid. Selain itu, respon peserta didik terhadap handout Pteridophyta pada uji coba terbatas maupun uji coba luas dalam kriteria sangat baik. Dengan demikian, handout Pteridophyta yang dikembangkan adalah layak digunakan untuk melatih keterampilan berpikir kritis dalam pembelajaran biologi.</i>

A. Introduction

The independent learning curriculum is a curriculum designed to simplify learning in the previous curriculum so that students can achieve competencies, especially being able to train critical thinking in the era of revolution 4.0. Mardiyah (2019) explains that students must be able to think critically about the phenomena that occur, this is due to the pace of information that develops in the technological era. The Industrial Revolution 4.0 wants an education system that can make changes, design and solve problems (Utomo & Wihartanti, 2019; Suyidno et al., 2020). In reality, students tend to be unable to think critically, this is because they have difficulty when solving the questions given, and their inability to identify and connect actual phenomena (Nandaria et al., 2020). One of the causes of students' low critical thinking skills is their lack of active participation in learning and the use of teaching materials that do not change tends to make students feel bored. Ermin & Marsaoly (2021) explained that textbooks containing complex material and unattractive images tend to make students passive in learning.

Critical thinking means inviting students to systematically analyse and organise data (Agnafia, 2019). Based on the results of the analysis of teachers and students related to the use of teaching materials, schools only use available textbooks as supporting teaching materials; the teacher's perception regarding the available textbooks is that the content of the material is not learner-centred, the presentation does not include the natural environment where they live and does not teach students to practice independently or collaboratively. This causes students to tend to be passive and have no interest in reading because they tend to read only part of the text. Hence, they want teaching materials that are practical, feasible for long-term use, and teaching materials that contain language that is easy for students to understand. Based on these problems, there is a need for teaching materials that contain concise material and real pictures to make it easier for students to understand the reading and include exercises that are done both individually and in groups to train their critical thinking skills.

Hasanah et al. (2018) explained that handouts are very effective in the learning process, especially in training students to think critically. This is in line with Suryani et al. (2021) and Priyadi et al. (2018) that handouts can be developed by themselves which aim to facilitate learning, increase interest in education, and do not require a long-time allocation compared to the available package books. In addition, the development of handouts means students do not need to re-record the material because the material contained therein is the essential points that have been summarized.

Some previous studies that successfully developed handouts oriented to critical thinking skills

include Wahyuna et al. (2022), who developed a valid, practical, and effective wetland e-handout. The developed handout is very flexible, so it can be used anytime and anywhere, but the e-handout is only suitable for use in areas with adequate internet access. Rozalia et al. (2018) developed a handout of biodiversity material to add references to SMAN 1 Hulu Palik teaching materials. This is due to the lack of teaching materials that match the characteristics of students at the school. Siahaan et al. (2021) developed a handout of ferns in class X of SMAK Frater Don Bosco; based on the data presented, it can be concluded that the handout received a good response from students.

The handout developed is the pteridophyte plant materials of the Tahura Sultan Adam are found. In addition, the characteristics of this handout are packaged interestingly with actual pictures in each reading, there are critical thinking exercises that are done independently and in groups on sub-materials, and there is a glossary to make it easier for students to understand terms that are not understood, include learning outcomes and objectives.

Quoted from the Depdiknas website (2008), the stages that need to be considered when compiling handouts are conducting curriculum analysis so that the handouts developed are according to the learning outcomes set by the curriculum, determining the title according to the topic discussed, collecting relevant literature into one reading that is easy for students to understand, there are practice questions to measure the cognitive abilities of students on handouts and passing the revision stage from experts. In addition, the analysis of learning objectives needs to be considered so that the objectives developed are based on the learning outcomes that have been determined (Kantun & Budianto, 2016). The handout functions so that students do not need to record material because the handout developed only lists the important points of the material so that students only need to read and understand. Another function of handouts is to facilitate teachers and students in the learning process so that it does not require long learning hours to understand one learning outcome (Aulyana et al., 2021; Fitriani, 2017). Therefore, this study aims to analyze the feasibility of the Pteridophyta handout in Tahura Sultan Adam Area-oriented critical thinking skills of high school students. Feasibility will be reviewed based on validity criteria and practicality based on the student's responses to using handouts in limited and extensive trials.

B. Material and method

This research and development refer to the 4D model of Define, Design, Development, and Dissemination (Thiagarajan, 1974). The location of this research is SMAN 4 Banjarmasin class X Biology subject. Before

conducting field trials, go through the expert validation stage to obtain input and suggestions for improvement so that the final product is categorized as at least valid. The next stage of field trials consists of two stages: a limited trial involving 8 students and a broad trial comprising 25 students. Field research is needed to determine the level of learner response to the handout and whether it gets a positive response or vice versa. The validity instrument includes 21 aspects, including the use of handouts, appearance, content, and the ability of researchers to develop handouts.

The learners' response contains 18 aspects of their understanding of learning using handouts, appearance, and exercises in teaching materials that can train critical thinking skills. Data analysis of the results of expert validation of handouts using formulas and rubrics adapted by Akbar (2013), that: $100 \geq \text{very valid} > 80$, $80 \geq \text{valid} > 60$, $60 \geq \text{moderate} > 40$, $40 \geq \text{less valid} > 20$, $20 \geq \text{not valid}$. Then, analyze learner response data using the rubric: $100 \geq \text{very good} > 80$, $80 \geq \text{good} > 65$, $65 \geq \text{enough} > 55$, $55 \geq \text{less good} > 40$, $40 \geq \text{not good}$ (Suyidno et al., 2022).

C. Results and discussion

Pteridophyta plants in the handout developed refer to the types found by Gunawan & Huda (2020). As many as 16 species were found, but the handout only describes 12 species; this is due to the absence of 4 other species, and the existing supporting literature is very lacking. The 12 types of pteridophyte plants in question are *Adiantum tenerum*, *Asplenium nidus*, *Cystopteris montana*, *Drymoglossum piloselloides*, *Gleichenia linearis*, *Lycopodium cranium*, *Nephrolepis bisserata*, *Nephrolepis cordofolia*, *Pteridium aquilinum*, *Pteris vittata*, *Pyrrosia numularifolia*, and *Stenochlaena palustris*.

This research and development process uses the 4D model for the explanation of the flow as follows:

- 1) Define, based on the front-end analysis, it is concluded that teachers and students still do not understand pteridophyta material due to the lack of supporting books, and teachers have never developed teaching materials related to pteridophyta. Therefore, teachers and students want pteridophyta teaching materials that are practical, feasible to use in learning, and by the curriculum that applies in the research school, namely independent learning.
- 2) Design, handouts are developed only as enrichment materials, so they do not replace the main role of package books that apply at school. The handout framework developed adapts Prastowo's (2015) teaching materials. The framework for the handout is shown in Table 1. Based on Table 1 above, here are the cover design and author identity (Figure 1), some features in the handout (Figures 2, 3, and 4), and Glossary.

Table 1 Handout framework

Handout framework
Preliminary part • Front cover • Table of contents • Preface • Concept map • Handout identity • Learning outcomes • Learning objectives • Brief description of the material • Instructions for use
Content section • Definition and characteristics of pteridophyta plants • Pteridophyta plant habitat • Life cycle of pteridophyta plants • Group Discussion (I) • Exercise • Classification of pteridophyta plants • Group discussion (II) • Parameters of Tahura Sultan Adam Mandiingin • Types of pteridophyta plants that live in Tahura Sultan Adam • Benefits of pteridophyta plants
Closing section • Conclusion • Final evaluation • Glossary • Bibliography • Identity of the author

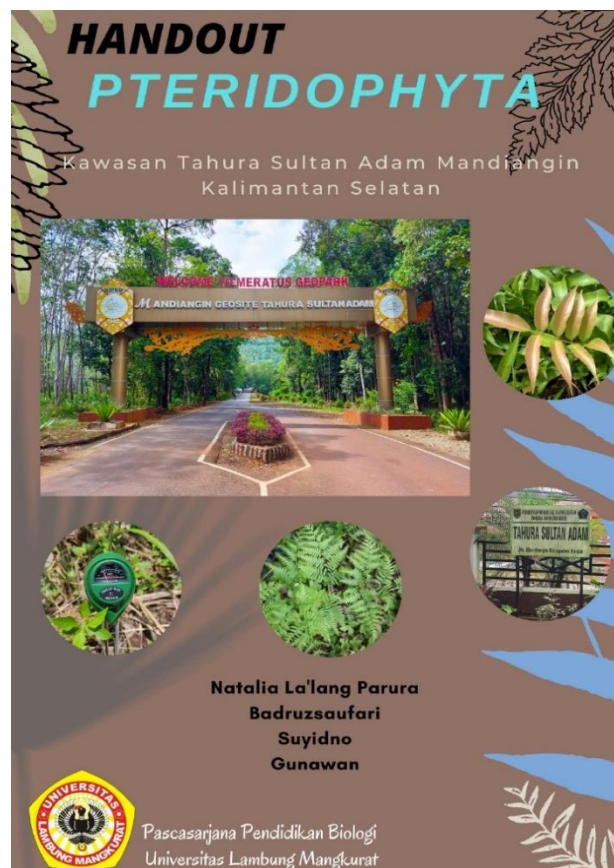


Figure 1 Book cover and author's identity (in Indonesian)



Figure 2
Critical thinking exercises contained in each sub-learning material
(in Indonesian)



Figure 3 Conclusion features (in Indonesian)

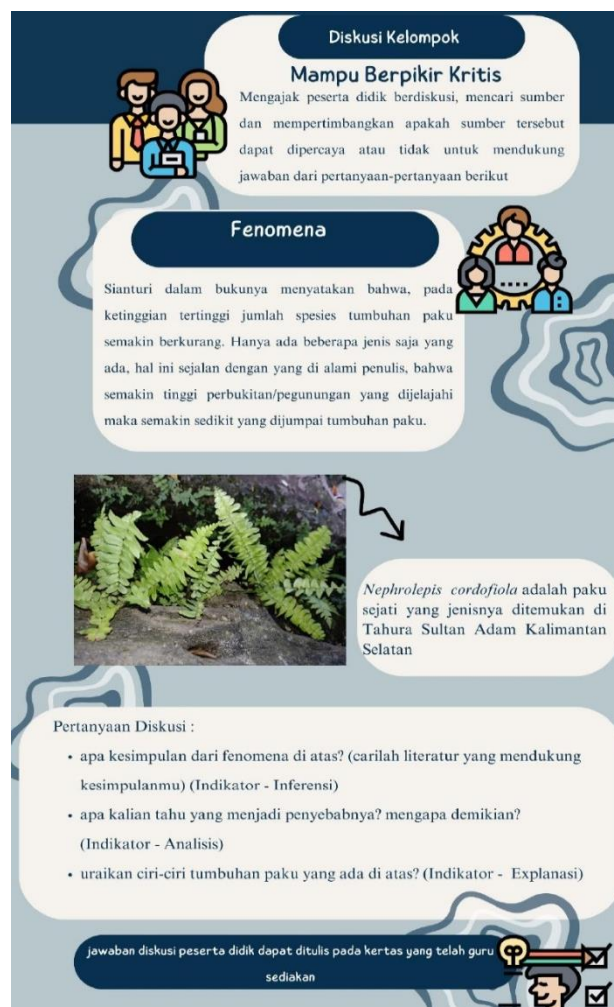


Figure 4 Group discussion materials (in Indonesian)

3) Development, the results of handout development, then enter the expert validation stage; this study involved 3 validators. The following data analysis results are presented in Table 2.

Table 2 Handout validation analysis results

Aspect	Score			Average Value
	V1	V2	V3	
Learning objectives are relevant and appropriate to the material	5	5	4	4.66
Learning objectives are designed to be meaningful to the teacher	4	5	4	4.33
Learning objectives are designed to be meaningful to the teacher	5	4	4	4.33
Clarity between resources and learning objectives	4	5	4	4.33
Learning objectives are derived from other sources	4	3	4	3.66
Relevance of content to learning objectives	4	5	5	4.66
Content presentation is theoretical and complete	5	4	5	4.66
Definitions and explanations are presented in full	5	4	5	4.66
There are technical terms, formulas, and symbols presented together with a complete explanation	5	4	4	4.33
Presented examples in each sub-material	4	4	5	4.33
The images presented are appropriate and up-to-date	4	5	4	4.33
Glossary attached	4	4	5	4.33
The author's ability to develop handouts	5	4	4	4.33
Maximum Score				4.3
Category				Very valid

(Source: Data processing)

Table 3 Analysis of students' responses

Aspect	Response Value	
	Limited	Broad
Learning with handouts makes me enthusiastic about learning.	90.0	92.0
The biology learning activities that have been implemented help me understand problems more easily when studying biology.	91.0	89.0
The learning activities that have been carried out require me to link biological problems with realistic situations.	100.0	92.0
I am sure I can understand all the contents of this handout well.	100.0	97.0
I used the experience I gained to work on the questions in the handout.	87.0	94.0
This learning makes me happy to discuss with group members how to solve problems by exchanging answers.	86.0	92.0
The discussion activities and exercises in the handout helped me to develop my biology skills.	81.0	87.0
From each activity in this handout, I can conclude and take important ideas about Pteridophyta.	85.0	88.0
I always try to solve problems in my own way.	85.0	86.0
I can relate the content of this handout to things I have seen, done, or thought about in my daily life.	83.0	88.2
This learning makes me express ideas or opinions about the given problem.	92.0	89.3
With this learning, I find it easy to conclude a problem solution.	89.0	89.0
After studying Pteridophyta using this handout, I believe that I am more capable of critical thinking.	94.0	90.0
After studying Pteridophyta learning, I know more about the types of ferns found in the Tahura Sultan Adam area.	87.0	91.0
After studying Pteridophyta learning on this handout, I increasingly know what are the benefits of ferns for living things.	100.0	95.0
This handout presents some questions that train my critical thinking skills.	100.0	94.0
The content of the handout is very useful and suits my needs.	88.0	90.1
Maximum Score	90	85
Category	Very good	Very good

(Source: Data processing)

Product validation was conducted by three expert instructors who completed the questionnaire. This tool identifies the relationship between the learning objectives in the educational module and the content of the handout, the learning objectives that are meaningful to teachers and students, the material presented theoretically in response to the learning objectives, and the ability to develop skills. It consists of 13 aspects. The validity function measures the dimensions and concepts developed. The higher the score, the better the product (Hendryadi, 2017). Based on the expert validity test results, the learning objectives from other literature obtained an average score of 3.66, which is lower than other aspects. However, the score is still in the same category as other aspects, namely, the excellent criteria. Determining learning objectives at the specified stage already refers to core and essential competencies, student characteristics, and teaching materials. Overall, it was concluded that the handout developed was included in the very valid category with a score of 4.3 so that this research could continue to the development trial stage. The trial in this study is divided into two stages, namely limited and broad trials. Based on the analysis of students' responses, the scores obtained are presented in Table 3.

The results of the analysis of students' responses show several aspects that are considered as the advantages of handouts, namely learning using

handouts that are developed to train students to link biological problems with realistic things, students' understanding increases after studying handouts, and students are better able to improve their critical thinking skills. The material on the handout is designed to be simple, brief, and straightforward, making students quickly understand the material and achieve learning objectives. By using handouts in the learning process, students can learn at their own pace and be able to follow the sequence of thoughts logically; combining text and images on handouts will add attractiveness and facilitate the delivery of information, and handouts are very economical (Ni'mah & Pujiastutik, 2018).

Some learners misunderstood some statement points, so they received low scores even though they did not affect the total score obtained. To avoid misunderstanding, the statement can be anticipated by accompanying students in filling out the questionnaire. Students feel happy and enthusiastic when learning using the developed handout. The primary learner response test aims to see students' reactions to learning using the teaching materials developed (Dermawati et al., 2019). Based on Table 3, it can be concluded that students' responses are very positive towards the developed handout. The presentation of handouts can train their critical thinking; after studying Pteridophyta material, students increasingly know what types of ferns can

live in South Kalimantan, especially Tahura Sultan Adam. The overall score of students' responses is very good categories. This is in line with the results of research by Bayu et al. (2023) that the advantages of the Pteridophyta E-Material in Bantarbolang Nature Reserve that he developed, such as being presented with contextualized image examples, collaboration the scientific approach, process skills, and critical thinking that facilitate its use. The development of Pteridophyta teaching materials is valid and effective and received good responses from teachers and students in practising critical thinking skills (Kurniawati, 2023; Ridhana et al., 2021; Rusmana et al., 2023; Yunita et al., 2022). The fundamental implication of the results of this study is that the handout that has been developed can be an alternative biology teaching material to train students' critical thinking abilities.

D. Conclusion

The Pteridophyta handout is valid and practical, so it is suitable for teachers to train high school students in critical thinking skills. This handout is designed in a free format; there are practice questions in each sub-chapter of the material, a conclusion feature in each reading, and real pictures that facilitate understanding of the material. The experts agreed that the handout had an average validity score of 4.3 with very valid criteria. In addition, students' responses to the Pteridophyta handout in the limited trial and broad trial were very good. To meet the criteria of high-quality handouts, research is necessary to test the effectiveness of these handouts in learning biology at school.

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