



Professional *Flip-Pdf-Based* Interactive Modules to Enhance The Creative Thinking Skills and Collaborative Skills of High School Students

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ABSTRAK

Kemampuan berpikir kreatif dan kolaboratif siswa yang belum optimal karena suasana belajar tidak interaktif dan kurang variasi penggunaan media pembelajaran. Penelitian ini bertujuan untuk mengembangkan media pembelajaran E-modul interaktif berbasis *flip-pdf-professional* yang dapat meningkatkan kemampuan berpikir kreatif dan keterampilan kolaboratif siswa. Metode yang digunakan dalam penelitian yaitu, Research and Development dengan model pengembangan 4D (define, design, develop dan disseminate). Data dikumpulkan menggunakan metode observasi, wawancara, angket dan tes. Analisis data secara deskriptif kualitatif dan kuantitatif. Hasil penelitian menunjukkan bahwa produk E-modul interaktif berbasis *flip-pdf-professional* valid dan sangat praktis digunakan dalam pembelajaran biologi di Sekolah Menengah Atas. Produk E-modul yang dikembangkan cukup efektif dalam meningkatkan kemampuan berpikir kreatif dan ketrampilan kolaboratif siswa pada pembelajaran biologi. Penelitian pengembangan E-modul interaktif berbasis *flip-pdf-professional* lebih praktis digunakan guru dalam pembelajaran dan membantu siswa dalam belajar mandiri.

ABSTRACT

The ability of students to think creatively and collaboratively is not optimal because the learning atmosphere is not interactive and lacks variety in the use of learning media. This research aims to develop interactive e-module learning media based on *flip-pdf-professional* that can improve students' creative thinking skills and collaborative skills. The method used in research is research and development with a 4D development model (define, design, develop, and disseminate). Data were collected using observation, interview, questionnaire, and test methods. Descriptive, qualitative, and quantitative data analysis. The results showed that the *flip-pdf-professional*-based interactive E-module product is valid and very practical to use in biology learning in senior high school. The E-module product developed is quite effective in improving students' creative thinking skills and collaborative skills in biology learning. Research on the development of interactive e-modules based on *flip-pdf-professional* is more practical for teachers to use in learning and helps students with independent learning.

1. INTRODUCTION

Learning appropriate for students in the 21st century must integrate various approaches that support the development of critical and creative skills and the ability to collaborate and communicate. One of the main approaches is project-based learning (Faridy & Rohendi, 2022; Mulcahy & Wertz, 2021). Students are involved in real-life projects encouraging them to solve problems, work in teams, and apply knowledge in practical contexts. In addition, technology-first learning, such as digital tools and online resources, allows students to access information and collaborate globally (Davidi et al., 2021; Scherer et al., 2019; Susanto et al., 2022). Developing critical thinking skills is also very important; students must be trained to analyze information, evaluate arguments, and make evidence-based decisions (Lestari & Annizar, 2020; Trimahesri & Hardini, 2019). By combining these approaches, education in the 21st century can prepare students to be innovative and collaborative thinkers and to face global challenges confidently.

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Other 21st century abilities that are no less important to train are collaboration skills, by training students to be able to contribute actively in their study groups, work productively, responsibly, flexibility and respect others (Bakti et al., 2023; Kusumantoro et al., 2022). However, because the learning process is still teacher-centered, students' higher-order thinking and collaborative skills are still lacking (Niu et al., 2021; Nurhidayat et al., 2023). One of the factors Indonesian students have poor creative thinking abilities is that teachers do not create innovative learning tools to help pupils think more creatively (Khoiriyah et al., 2022; Pamungkas et al., 2020). The current conditions of the disruption era have an impact on the development of education, both in developed and developing countries. 21st-century learning presents challenges for students to develop crucial learning and innovation skills (Triyono et al., 2022; Yuberti et al., 2019). Student skills and innovations can be extracted from improving the quality of learning from teachers by providing interactive learning resources (Parapat & Sagala, 2022; Supandee & Yachulawetkunakorn, 2023). One form of learning resource innovation is utilizing e-module technology that is systematically designed to encourage learning skills (Dewi et al., 2019; Pujiati et al., 2022). E-module utilizes information and communication technology that can be used by students independently so as to support the digital literacy movement as one of the needs of the 21st century (Bakti et al., 2023; Hermansyah & Pammu, 2023).

The problem that often occurs in elementary schools is the need for digital-based modules. Previous research findings also revealed that teachers struggle to develop E-modules in learning activities (Fairuzi & Bentri, 2021; Rahmatunisa et al., 2022). In addition, the lack of training for teachers in using E-modules effectively can result in them being unable to maximize the potential of digital materials, which impacts student understanding (Darmayasa et al., 2018; Wandani et al., 2023). Challenges in providing appropriate feedback to students through digital platforms can also affect their development. The results of observations that were made at SMAN 6 Palu on August 15, 2023, show that biology teachers still lack knowledge on the use and development of variations in learning media, including digital-based such as e-modules. Another problem is that teachers still use lecture methods, and use less interactive textbooks that cause students boredom. Biology teaching materials examine the symptoms and facts in the surrounding nature so that an in-depth understanding of concepts and students' scientific process abilities are needed.

The use of interactive e-modules is expected to enhance students' creative thinking and increase students' effectiveness and collaboration ability (Cynthia et al., 2023; Sumarmi et al., 2021). Professional pdf flip-based e-modules can help students become more adept at using their creative thinking, and they can provide as a cutting-edge resource for teachers during the teaching and learning process (Priantini & Widiastuti, 2021; Sakinah et al., 2023). Based on these problems, it is very important to conduct research on the development of interactive e-modules based on *flip-pdf-professionals* to improve students' creative thinking skills and collaborative skills in biology learning at SMAN 6 Palu.

E-modules can be developed using a professional *flip-pdf-application* to enhance learning and make learning more interactive. Students need to have critical thinking abilities, problem solving skills, teamwork and communication abilities, creativity, and innovation in order to succeed in 21st century learning (Wang et al., 2018; Zainudin & Istiyono, 2019). Creative thinking is one of the most crucial 21st century skills for both academic success and future life (Hobri et al., 2021; Toheri et al., 2020). Creative thinking skills can be measured from students ability to produce varied answers or provide interesting alternative solutions to a problem (Festiyed et al., 2023). There has been no study on professional interactive modules based on flip-pdf to improve high school students' creative thinking skills and collaborative skills. Based on this, this study aims to develop a professional interactive module based on flip-pdf to improve the creative thinking and collaborative skills of high school students.

2. METHOD

This research is a type of research and development and follows the model developed by (Roman 2022 ; Umar, Purwanto, and Al Firdaus 2023). The development steps carried out in this study can be seen in Figure 1. The method used to collect data is a questionnaire. The instruments used in this study are; a validity questionnaire that will be validated by two expert validators to assess the validity of the e-module, a practicality questionnaire obtained from the response of biology teachers at SMAN 6 Palu, a creative thinking skills test instrument, and collaborative questionnaire given to 27 students in grade XI Science 1 SMAN 6 Palu, to measure the effectiveness of e-module on improving students' creative thinking ability and collaborative skills. The validity results of the interactive e-module based on *flip-pdf-professional* will be determined by the average percentage of assessment from all validators and interpreted based on the validity category according to (Shabiralyani et al., 2015), according to Table 1.

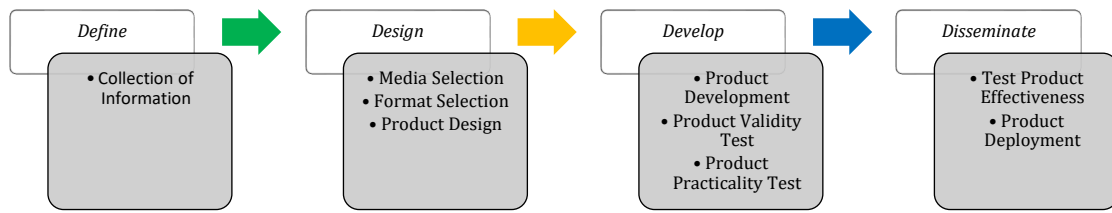


Figure 1. 4D Model Development Stages

Table 1. Validity Test Category

Percentage (%)	Validity Category
86-100	Valid
66-85	Fairly Valid
46-65	Less Valid
25-45	Invalid

(Haking & Soepriyanto, 2019)

The practical test of the interactive e-module based on *flip-pdf-professional* is assessed through a questionnaire instrument given to teachers on the practicality of the e-module. Teacher responses to each criterion will be averaged and categorized based on the practicality category in Table 2.

Table 2. Practicality Test Category

Percentage (%)	Category
86-100	Very Practical
66-85	Practical
46-65	Less Practical
25-45	Impractical

(Daryono et al., 2023)

The e-module's efficacy value is obtained from the level of the student's creative thinking ability and collaborative skills after being tested on biology learning. Analysis of students' creative thinking skills is obtained through pre-test and post-test results. These results were analyzed using the N-gain test. The results of the N-gain analysis are classified according to the category of Table 3. While the results of students' collaborative skills were obtained from the average percentage of student responses after using the professional PDF *flip-based-interactive* e-module, the results of this calculation were interpreted using the classification in Table 4.

Table 3. N-Gain Category Students' Creative Thinking Ability

N-Gain Value	Classification
$g \geq 0.7$	Tall
$0.3 \leq g < 0.7$	Currently
$g < 0.3$	Low

Table 4. Student Collaborative Skills Category

Percentage (%)	Category
>80	Very Collaborative
>60-80	Collaborative
>40-60	Quite Collaborative
>20-40	Less Collaborative
≤20	Not Collaborative

(Nurmayasari et al., 2022)

3. RESULT AND DISCUSSION

Result

The results of research and development of interactive e-module learning media based on *flip-pdf-professional* consist of four stages. The first stage is the defining stage (define), at this stage, the activities carried out are observation and interviews to analyze the state of biology learning, obstacles faced during learning, curriculum analysis, and the needs of learning media at SMAN 6 Palu school. The results of observations that have been carried out at SMAN 6 Palu that the learning resources and learning media used in biology learning at the school are in the form of textbooks. The facilities and infrastructure provided at SMAN 6 Palu school are in focus, but subject teachers sometimes use it because it is related to the method used to teach, that is, the lecture method and teachers have not applied learning media in digital form. This supports this research process because most of the students of SMAN 6 Palu have smartphones making it easier for researchers to develop digital teaching materials. The curriculum analysis used as a learning reference is the 2013 curriculum.

The second stage is the design. At this stage, the activities carried out consist of designing interactive e-module product concepts based on *flip-pdf-professional* and preparing research instruments. The e-module product developed consists of a cover containing the title, school level, and author's name. Introduction containing table of contents, foreword, concept map, and guide to using e-modules. Learning materials contain material summaries and evaluation questions. The glossary contains definitions of words that are difficult to understand to facilitate students' understanding in learning. While the last page of the e-module includes, a bibliography containing references used. The cover of the e-module showed in [Figure 2](#), which is the initial view when you first open the e-module.



Figure 2. Design Based Interactive E-Module Cover *Flip-Pdf-Professional*

The third stage is development, at this stage validity tests are carried out by expert validators. The results of the validity test can be seen in [Table 5](#).

Table 5. Based on Interactive E-module Validity Test Results *Flip-Pdf-Professional*

No.	Rated aspect	Score		Percentage (%)	Category
		Validator 1	Validator 2		
1	Material Suitability	3.0	3.7	83.8	Fairly valid
2	Material Accuracy	3.5	3.75	90.6	Valid
3	Learning Support Materials	3.3	3.3	82.5	Fairly valid
4	Appropriateness To The Level Of Understanding	3.5	3.5	87.5	Valid
5	Communicative	3.5	3	81.3	Fairly valid
6	Compatibility with Correct Indonesian	3	4	87.5	Valid
7	Use of Terms	3	4	87.5	Valid
8	Display Aspect	3.4	3.4	85.0	Fairly valid
9	Benefit Aspect	3	4	87.5	Valid
Average Total Validation Value				86.0	Valid

Based on the results of the validator team's assessment in Table 5, shows that the *flip-pdf professional*-based interactive e-module gets 86.0% results with valid categories. Meanwhile, the results of testing the validity of the e-module obtained comments, inputs, and suggestions provided by expert validators as revision material for the improvement of the developed product. The suggestions given include font usage size, font color, and display in the evaluation section. At the development stage, a practical test of the e-module was also carried out, which was assessed by biology subject teachers at SMAN 6 Palu. The practical results of the e-module can be seen in Table 6.

Table 6. E-Module Based Practicality Test Results *Flip-Pdf-Professional*

No.	Rated aspect	Score
1	Learning using interactive e-modules based <i>flip-pdf-professional</i> is very interesting	4
2	The images presented in the e-module are appropriate to the material and interesting	4
3	The presentation of material in the e-module is arranged systematically	4
4	The sentences/grammar in the e-module are easy to understand	4
5	The colors presented in the e-module are appropriate and contrasting	4
6	The type of font used is appropriate and easy to read	3
7	Practice questions on learning media can foster students' creative thinking abilities	4
8	Interactive e-modules can be studied by students independently or in groups	3
9	The learning videos presented in the e-module are appropriate to the material and interesting	4
10	E-modules are easy to use anywhere	4
11	E-modules can be used repeatedly	4
12	E-modules are easy to access	4
13	E-modules can help students to be active in the learning process	4
Average		3.8
Percentage		96 %
Category		Very Practical

Data on students' creative thinking skills were obtained from the results of the pre-test and post-test as many as 4 questions were given to 27 students in class XI Science 1 SMAN 6 Palu. The goal is to determine the improvement of students' creative thinking skills after implementing a reciprocal e-module based on *flip-pdf-professional*. The results of the creative thinking skills test are classified based on the N-Gain classification and can be seen in Table 7.

Table 7. N-gain Results of Students' Creative Thinking Ability

Test	Average	Maximum Score	N-gain	Category
Pre-test	1.40	4	0.618	Currently
Post-test	2.96			

Based on Table 7, students' capacity for creative thought increased in the medium group so it can be proven that interactive e-modules based *flip-pdf-professional* are effective in improving students' creative thinking abilities. Apart from that, a test of the effectiveness of the e-module on students' collaborative skills was also carried out. Data on students' collaborative skills was obtained from the results of a collaborative skills questionnaire filled out by students after implementing the *flip-pdf-professional* interactive e-module product, which is shown in Figure 3. The cooperative skills of the students reached 82.7% and they can be classified as very cooperative. This shows that professional *Flip-Pdf-Based interactive* e-modules effectively improve students' collaborative skills. After using professional *Flip-Pdf-Based* e-modules, the student can actively participate in study group discussions, cooperate, take responsibility in study groups, create good communication between groups, respect the answers of friends in the group, and receive comments or suggestions from friends in the group.

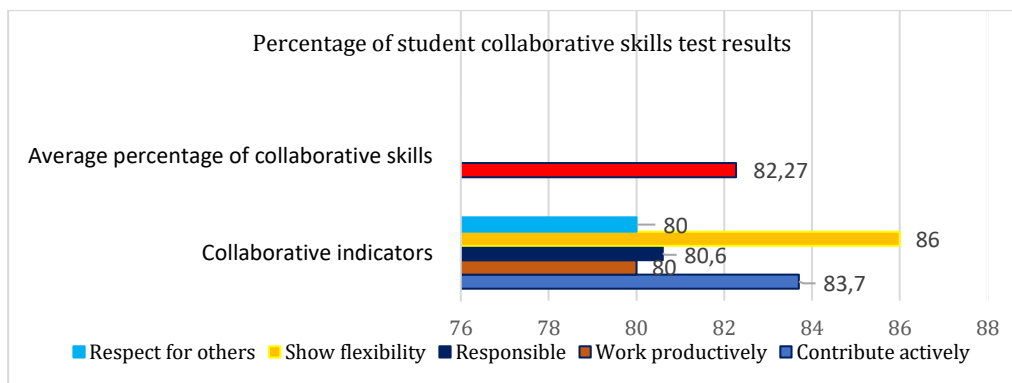


Figure 3. Percentage Results of Student Collaborative test Skills

Discussion

This development research produces development products in the form of interactive e-module learning media based on *flip-pdf-professional* that can improve students' creative thinking skills and collaborative skills and is devoted to environmental change material in high school. This research was developed with a 4D development model, which consists of 4 stages, namely the define, design, develop, and disseminate stages. The application of the 4D model research and development method is carried out because of its advantages, namely the process is fast but still has a complete and systematic description of the stages, and the results of the development product have been tested because before being deployed, a product assessment is conducted by experts, namely material experts and media experts (Fauziah et al., 2023; Kosassy, 2019; Salsabila et al., 2023).

Professional *Flip-Pdf-Based* e-module media has gone through a validation process. Before being tested on students, the developed product needs to pass the validation stage, which is overseen by professionals who are meant to offer an evaluation of the development product and recommendation for enhancement (Pham et al., 2019; Triwoelandari et al., 2023). The results of the product validity test show that the interactive e-module based on *flip-pdf-professional* developed is valid with a validity percentage of 86.0%. The display of e-modules is arranged systematically and contains interesting content such as pictures and learning videos that are by the learning material to be taught. Learning media needs to be supported by interesting content such as learning images and videos to provide interest and minimize boredom in students (Sabella et al., 2022; Shabiralyani et al., 2015). This can increase students' concentration to receive learning materials so that they can be adjusted to the needs and changing times.

After going through the validation stage by the validator team, learning media products were also tested for practicality to assess teacher responses. The practicality test aims to determine the level of ease of content and suitability of the e-modules developed, when implemented in the biology learning process (Darling-Hammond et al., 2020; Hidayat et al., 2021). The results of the practical test of the professional *Flip-Pdf-Based* interactive e-module to measure students' creative thinking skills and collaborative skills in biology learning at SMAN 6 Palu obtained a percentage of 96% and were categorized as very practical. If the created e-module product for biology education is simple to use, it will be able to foster students' creative thinking skills. This module has benefits, it can be studied by students independently or in groups, used repeatedly, easily accessible, and helps students be more active in the learning process. E-module products when they can be used sustainably and when applied in the learning process in schools can create a learning atmosphere that pleases students and facilitates the knowledge transfer process ((Sidiq & Suhendro, 2021; Toheri et al., 2020).

The results of the collaborative skills aspect of students obtained a score of 82.7% and were categorized as very collaborative. This shows the professional *Flip-Pdf-Based* interactive e-module is effective in enhancing students' collaborative skills. The positive thing obtained after using the professional *Flip-Pdf-Based* e-module is that students can contribute actively in group discussions, be able to work together, be responsible in study groups, establish good communication between groups, appreciate friends' answers, and receive suggestions from their group mates. E-modules with collaborative learning are most effective in producing significant increases in self-efficacy, motivation, and learning outcomes (Delita et al., 2022; Sofyan et al., 2019). The ability of students to work well in groups, guide and lead peers, manage tasks systematically, be responsible, and engage with other students effectively are all indicators of their collaboration skills (Art R. Napoles, 2022; Priantini & Widiastuti, 2021). The results of the effectiveness test of the professional *Flip-Pdf-Based interactive* e-module on students' creative thinking and collaborative skills showed good and effective categories. This is in line with research explaining that e-modules developed with the *flip-pdf-professional* application can improve students' problem-solving

abilities (Annam et al., 2023; Widya et al., 2021). With its page edit feature, *flip-pdf-professional* is a flipbook maker program that allow users to create interactive book pages with quizzes, audio and video content from YouTube, photos, and other media (Bakti et al., 2023). Meanwhile, other researchers mentioned that E-modules can be a source of learning media that can improve thinking skills and 21st-century skills (Nurmayasari et al., 2022; Fikrina et al., 2023). Some relevant research related to the development of learning media e-modules based on *flip-pdf-professional* E-module based on *flip-pdf-professional* has never been developed to test its effectiveness on aspects of creative thinking ability and aspects of collaborative skills as one of the learning abilities of the 21st century. Therefore, the study of developing interactive e-modules based on *flip-pdf-professional* is expected to enhance students' creative thinking skills and collaborative skills in high school biology learning, especially on environmental change material. In addition, the results of the carried out research showed that the professional *Flip-Pdf-Based* interactive e-module was valid and practical to be used as a biology learning medium in high school, and the professional *Flip-Pdf-Based* interactive e-module was effective for improving students' creative thinking skills and collaborative skills at SMAN 6 Palu.

The contribution that can be made from this research is that the e-module product that has been developed can be used as a learning medium and additional learning resource in biology learning, especially in environmental change material. In addition, this research can be used as a reference for the use of digital learning media. However, there are limitations of this study, namely, this research only develops professional *Flip-Pdf-Based* e-modules in high school biology subjects on environmental change material, so it is hoped that future research can develop it with more varied material. E-module learning tools developed using *flip-pdf-professional* have proven effective in improving students' creative thinking skills and collaborative skills, so that in future research it is necessary to conduct a study of e-module development on other 21st-century abilities.

4. CONCLUSION

The results of the development and validation of the professional *Flip-Pdf-Based* interactive E-module are declared valid and very practical to use in biology learning at SMAN 6 Palu. The application of professional *Flip-Pdf-Based* interactive e-module media in biology learning effectively improves students' creative thinking skills and collaborative skills. Research on the development of interactive e-modules based on *flip-pdf-professional* is more practical for teachers to use in learning and helps students with independent learning.

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