

Developing an e-Module on Blended Learning-based Calculus Courses

Febria Ningsih^{1*}, Ria Deswita²

Mathematics Education Department, IAIN Kerinci
Jalan Pelita IV, Sungai Penuh, Jambi, Indonesia

^{1*}*fbrianingsih@gmail.com*, ²*ria_deswita@ymail.com*

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Abstrak

Pengembangan e-modul mata kuliah kalkulus berbasis blended learning untuk mahasiswa Jurusan Tadris Matematika IAIN Kerinci menjadi fokus penelitian ini. Penelitian ini dilakukan karena terdapatnya hambatan didaktis khususnya untuk bahan ajar sebesar 64% yang menjadikan mahasiswa kesulitan untuk belajar. Pengembangan e-modul berbasis blended learning bertujuan menghasilkan e-modul yang dapat dikategorikan valid dan praktis agar dapat digunakan oleh mahasiswa. ADDIE merupakan desain dari penelitian dan pengembangan yang dilakukan. 30 orang menjadi subjek penelitian yang berasal dari mahasiswa jurusan tadris matematika IAIN Kerinci yang sudah dan sedang mengontrak mata kuliah kalkulus. Data diperoleh melalui teknik pemberian angket validitas dan angket praktikalitas lalu data dianalisis dengan cara deskriptif kualitatif untuk mendeskripsikan saran para ahli serta analisis kuantitatif untuk mengolah data hasil angket. Hasil penelitian menunjukkan bahwa e-modul berbasis blended learning pada mata kuliah kalkulus valid dan praktis.

Kata Kunci: Blended Learning; E-modul; Kalkulus.

Abstract

The focus of this research is the development of a blended learning-based calculus course e-module for students of the Mathematics Tadris Department at IAIN Kerinci. This research was carried out because there were didactic barriers, especially for teaching materials of 64%, which made it difficult for students to learn. The development of e-modules based on blended learning aims to produce e-modules that can be categorized as valid and practical so that students can use them. ADDIE is the design of the research and development carried out. 30 people who became the research subjects came from students majoring in mathematics at IAIN Kerinci who had and were currently contracting calculus courses. The data were obtained by administering validity and practicality questionnaires. Then, the data were analyzed using a qualitative descriptive method to describe the advice of experts and quantitative analysis to process the results of the questionnaire data. The results of this study obtained e-modules based on blended learning in valid and practical calculus courses.

Keywords: Blended Learning; Calculus; E-Module.

I. INTRODUCTION

The rapid development of technology is now penetrating beyond the industrial revolution era 4.0 and infiltrating the era of society 5.0 which has affected various aspects of life including the world of education. One of the impacts that occurs in the world of education is that technology can assist lecturers to provide innovation in the learning process. With the development of technology, lecturers may carry out the lecture process online. According to Damanik (2019) a learning process emerging in the revolution 4.0 which includes both face-to-face and online learning is defined as blended learning. It is also considered as one of learning innovations in the higher education setting (Diana et al., 2020; Putri, 2023).

Blended learning aims to improve the learning effectiveness (Husamah, 2014; Safitra, Hapizah, Mulyono, & Susanti, 2023) since various fields in higher education are currently utilizing blended learning to achieve higher learning effectiveness among students (Sharma & Shree, 2023). In line with the studies, Maya (2020) stated that one of the advantages of blended learning was the effectiveness value, as the learning process does not only occur in the classroom. According to Ningsih et al., (2018), blended learning could facilitate two types of learning systems at once, both face-to-face and online learning.

In general, blended learning could improve students' performance. Rovai and Jordan (2004) found that blended learning as a learning model could significantly influence students' learning outcomes. In addition, Ranjan's (2020) showed that blended learning encouraged students to

achieve better outcomes and performance and might promote student-centered learning. To reinforce the learning, it is necessary to provide suitable learning material. Hence, the face-to-face and online modes could be synced without any major problems (Chandra, & Listiani, 2023).

The learning materials could be developed through e-modules (electronic modules) that can be accessed anytime through computers or smartphones. The module as a learning source should be designed thoroughly and systematically to support self-directed learning processes. Thus, the designing process must consider some learning aspects such as the effectiveness of the module toward independent learning processes in order to encourage students to build their comprehension and concept of the topic independently. As stated by Serevina et al., (2022) e-module could promote students' critical thinking because it could be accessed anytime and anywhere through smartphones by which students might discover more sources to learn. It also encouraged students' interest to learn (Wijayanto et al., 2023).

E-modules are highly possible to specially develop on calculus courses. Calculus is a basic course to master in the department of Tadris Mathematics, IAIN Kerinci. It becomes a prerequisite before taking other courses such as advanced calculus and differential equations. Given the importance of calculus learning, the learning process in calculus courses must be designed and implemented with the appropriate methods, approaches and teaching materials (Mujib, 2017; Machmud, Pusi, & Pauweni, 2022).

The development of this e-module was based on Deswita et al., (2021) that discovered didactic challenges among the students in Tadris Mathematics department of IAIN Kerinci on calculus courses at 68%. One of the causes was related to the teaching materials. It was concluded that the students required appropriate teaching material to support the learning process.

A suitable learning material is a vital aspect to conduct a lecture. The sources used by the lecturer should respond to the didactic problems appearing in the learning setting. Before designing the syllabus, a lecturer is required to understand the students' backgrounds as they will be having different learning styles and performances. According to Widodo and Jasmadi (2008) learning material development was an alternative to create an effective learning process.

The form of e-modules on blended learning courses is usually in a PDF flip file. It is easy to read and able to store video and audio file by which students will be able to listen to the explanation visually. This is one of the advantages of e-modules, compared with the conventional ones (Cheva & Zainul, 2019; Halini, Zubaidah, Pasaribu, Mirza, & Afriansyah, 2023). Integrating the learning video will assist students to learn at their own pace as they are able to rewind or pause the video (Dewi et al., 2021).

Previous studies have found positive improvement on e-module development such as Sari's et al., (2022) that revealed the improvement of students' critical thinking skill while applying e-module on a blended learning airplane course. It is in line with Sari Rahayu et al., (2020) which discovered the

improvement of students' outcome on *hadits* courses with the same methods. Furthermore, Azizah et al., (2021) stated geogebra-assisted modules were appropriate to utilize on Calculus courses at high school level.

In conclusion, the e-module on blended learning is an innovation that plays as learning sources and material. However, there are still few studies on e-module on blended learning regarding Calculus courses at higher education level.

It is expected that the e-module development on blending learning-based Calculus courses could resolve the barriers in the learning process, especially in Calculus classes. Furthermore, the result of this study would be an e-module on blended learning and expected to be an alternative of learning and teaching sources for the lecturers and students of Calculus course.

The earlier explanation is strong evidence of the demand of valid and practical e-modul to use in the learning process.

II. METHOD

ADDIE was the development designing model chosen in this study because as Cahyadi (2019) stated that it was the most common design model to utilize in learning material development. The steps of ADDIE started from analyzing, designing, developing, implementing, and evaluating (Rayanto & Sugianti, 2020).

The study was conducted in IAIN Kerinci. It involved 30 students of *Tadris* Mathematics department. There were five students who had taken Calculus courses and they were chosen to be in the trial

group. Meanwhile, the other 25 students who were taking Calculus courses were considered as the respondents in the larger trial group. The data were collected using questionnaires due to its validity and practicality. The validation processes were conducted by 3 validators, who validated the media and material in the e-module being developed. The data of the validators' suggestions were later analyzed descriptively and the data of validity and practicality testing were analyzed quantitatively, presented in statistical numbers. The criteria of validity and practicality testing are presented in Table 1 and Table 2.

Table 1.
The criteria of product validity

Percentage (%)	Criterion
80 – 100	Valid
60 – 79	Fair
50 – 59	Less Valid
0 – 49	Not Valid

Source: Arikunto (2006).

Table 2.
The criteria of product practicality

Percentage (%)	Criterion
0 – 20	Not Practical
21 – 40	Less Practical
41 – 60	Fair
61 – 80	Practical
81 - 100	Highly Practical

Source: Riduwan (2008) in Yulisman and Usmeldi (2021).

III. RESULTS AND DISCUSSION

E-modul on Calculus blended learning course was the result or the product of this study. The e-modul had been validated by the experts, tested on students, and revised to ensure that it was eligible to use in higher education settings.

A. Results

Below are the results of the development process.

1. Analysis

The first step of the analysis was to validate the problems. Based on the questionnaire analysis, it was found that 64% of the challenges discovered were related to didacticism. These issues usually appeared when the students were having difficulty to master the learning material on the book as the learning source. Besides, using books during online learning contributed to the didactic challenges regarding the learning material.

The second step was to determine the objectives to address the problems. The results of the interview showed that the students were having problems in learning Calculus. The problems appeared as they could not understand the learning material in the book provided in the classroom. It was demanded to provide them with more appropriate learning materials to assist students to understand the learning material easily. These data were considered as the basis rationale of the researchers to draw conclusion that the students were in need of a new e-module that could present the learning material systematically and practically through languages that were easier to comprehend.

The third step was to analyze the learning process. The analysis results were used as the references to design the material in the e-module. The data obtained from the interview showed that the students studied calculus in high school, specifically in the derivation theme. It was assumed that the students had prior knowledge regarding the topic. It advantaged the construction of the learning material regarding calculus, especially in limit and derivation topics.

The fourth step was to observe the feasibility of the study by investigating the on-going calculus courses in the 2022/2023 academic year. In addition, the availability checking had been done by investigating the students who were taking the courses relating to the e-module being developed. These data were necessary to facilitate the trial process.

The fifth step was to plan the research. The initial work in this step as to determine the product to develop, namely calculus e-module. Secondly, the researchers decided the duration of the development process by 2-month. Lastly, budget analysis was conducted to estimate possible costs during the research and development process.

2. Design

Prior to e-modul designing, sources and references were collected, one of which was students' study plans. It provided the information of learning objectives and topics which were the main reference to design the e-module. e-modul. Afterwards, the books related to the learning topics were collected to be adjusted with the study plan.

The steps to design the e-module included module design construction of the cover or the outer of the module, preface, and table of contents. This was followed by the construction of the main contents presented through audio and video. The last section included some exercises to enhance students' understanding.

The designing process was later proceeded to the construction of the material and the exercises. The materials were designed based on various sources

that generated some indicators and learning objectives. The contents provided in the e-modul were written in Garamond font, 12 pt, to maintain the detail and readability. The exercises were carefully chosen to meet the requirement of the course. Other details such as background, cover, layout, and figures were designed to present a calculus theme by choosing a decent background and layout with fewer color choices.

The last step of the designing process was assessment construction including the validity sheet. The validity sheet was constructed based on the indicators of each aspect to be assessed. The questionnaires encompassed 18 items of 4 aspects, namely practicality, convenience, attractiveness, and efficiency.

3. Development

The e-module was validated by 3 experts or referred to as validators to assess content and material as well as assessments for display and presentation. Validation on the content and material aspects was carried out by Dr. Selvia Erita, M.Pd and Mesi Oktafia, S.Pd., M.Si as lecturers who administered Calculus courses at the Department of Mathematics Tadris FTIK IAIN Kerinci. Assessment or validation for content and material included five aspects of assessment, presented in Table 3.

Table 3.
The validation results on general content and material

Aspects	Percentage
Relevancy	95,8
Accuracy	87,5
Convenience	93,8
Attractiveness	87,5
Comprehensiveness	87,5
Average score	90,4

Criteria	Valid
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In Table 3, the average percentage of the five aspects of the assessment was 90.4%, indicating that the content and material contained in the e-module were valid. Furthermore, the assessment or validation of the appearance and presentation aspects was carried out by Dr. Selvia Erita, M.Pd. and Rilla Gina Gunawan, M.Pd. which included three criteria for the assessment aspects. Data on the results of validation of the appearance and presentation aspects are presented in Table 4.

Table 4. Validation results on display and presentation

Aspects	Percentage
Presentation	87,5
Functionality	93,8
Significances	90,6
Average score	90,6
Criteria	Valid

The average score of the three aspects on display and presentation was 90,6%. In terms of appearance and presentation, the calculus e-modules made were in the valid category. Thus, the calculus e-module based

on blended learning could be tested after revisions made on the validators' feedback. The following data presents the results of expert or validator feedback in Table 5.

Table 5. Expert's feedback

Aspects	feedback
content and material	<p>There are several explanations such as graphs, images, example problems that are less relevant to the material discussed and less relevant to the abilities and characteristics of students.</p> <p>Increase the number of videos explaining sample problems.</p> <p>Add answer guidelines for each exercise to support independent learning.</p>
display and presentation	<p>Exercises should be presented at the end of each sub-chapter.</p> <p>there are some mistakes in symbols and number typing.</p>

Revisions were made based on the feedback from the validators to be tested among participants in small groups and tested on large groups. The following is an overview of the developed module.

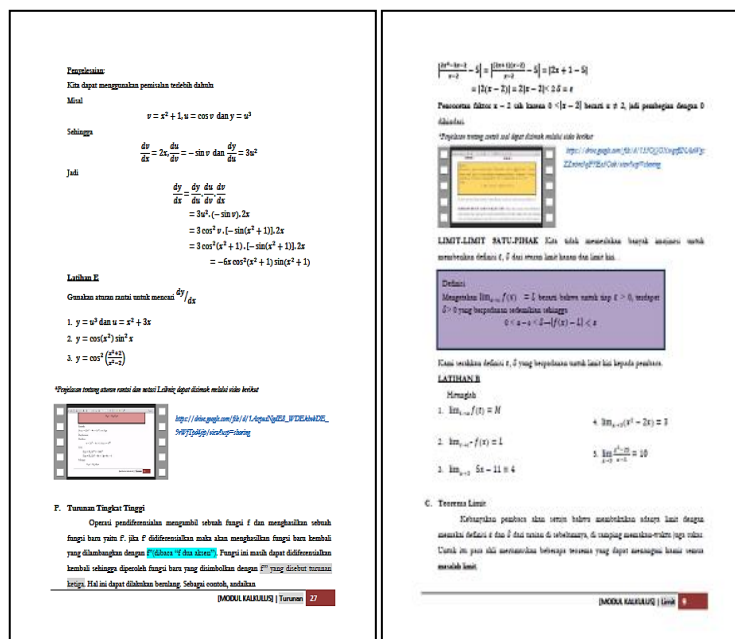


Figure 1. E-modul

Figure 1 shows an overview of the presentation of the developed e-module. There were exercises in each subchapter as well as explanatory videos to encourage students to learn independently.

4. Implementation

Products that had been declared valid based on the criteria were tested on small groups of 5 students by giving e-modules to students majoring in Tadris Mathematics IAIN Kerinci who had taken calculus courses. Data from the small group trial are presented in Table 6.

Table 6.
Overall Practicality Data of Small Group Trial

Aspects	Percentage	Category
Significances	80	Practical
Convenience	76	Practical
Attractiveness	80	Practical
Efficiency	75	Practical
Average score	77,8	Practical

Table 6 presents the overall average percentage of practicality at 77.8% in the practical category. Thus, the product testing for large groups of 25 students could be done without any revisions. The trial was conducted five times. Large group trial data are presented in Table 7.

Table 7.
Overall Practicality Data of Large Group Trial

Aspects	Percentage	Category
Significances	75	Practical
Convenience	77	Practical
Attractiveness	82	Highly practical
Efficiency	73	Practical
Average	76,6	Practical

Table 7 shows the result of the trial test on the larger group with the average score of 76,6%, namely practical category. It meant that the bended learning-based e-modul was theoretically practical to be use on calculus courses.

5. Evaluation

Each stage of the product development was evaluated including the analysis stage, design, development stage and implementation. The results of development and implementation was an e-module developed based on blended learning for calculus courses that was included in the valid and practical category. Thus, the e-module was appropriate to utilize in the learning process.

B. Discussion

The resulting product of the study was a blended learning-based e-module using flip pdf for calculus courses. The results showed that the percentage score of e-module validity was 90.4% on content and material as well as 90.6% on appearance and presentation which was included in the valid category according to the validity criteria. The results of the practicality test conducted in small groups were 77.8% and for large groups 76.6% which were categorized as practical. The aspects of practicality assessed were in the aspects of usefulness, convenience, attractiveness, and efficiency.

The validity and practicality results discovered that the e-module based on blended learning in calculus courses was useful for students to learn calculus as it was previously adjusted with the students' study plans and perfected by relevant materials and exercises. The significance of this result was in line with the research conducted by Rifa'l and Nisa' (2019) stating that e-modules could increase student learning independence in calculus material. In addition, Meilasari & Khotimah (2022) also

revealed that e-modules might improve learning students' outcomes in folding integral calculus topics.

The advantage of this e-module was the basis of the modul, which was a blended learning setting, which had not been developed by previous researchers. The e-module had been revised starting from simplifying the material, adding steps in explaining example problems to make it easier to understand, adding questions and answer guidelines to train students in honing their skills in calculus.

Revisions were also made with the addition of video and audio explanations so that students could learn independently, which was also the interesting point of this e-module. According to Rahmawati et al., (2021) video was an interesting factor in online learning. Video, which is also part of audio-visual media, could increase effectiveness during online learning (Nurfadhillah et al., 2021). Purwanti (2015) also revealed that video could motivate someone to learn. With an explanatory video, the e-module could be implemented on face-to-face and online learning. As stated by Alya et al. (2021), the use of e-modules was not limited to time and place.

The use of blended learning-based calculus e-modules could help students learn independently without having to be accompanied by lecturers. Because e-modules are one of the media to learn independently and aimed to achieve the desired learning competencies (Chairunisa et al., 2022). According to Hartono and Noto (2017), quality learning could be assisted by the use of modules in lectures. The use of e-modul improved the learning process atmosphere, and could be conducted

independently, thoroughly with providing comprehensible results (DEPDIKNAS, 2008).

E-modules on blended learning were expected to be the solution to the existing problems, namely didactical obstacles regarding the teaching materials encountered. Not only because of the advantages of e-modules but also learning with blended learning which was considered suitable for application in higher education settings, one of which was to teach mathematics as stated by Darma et al., (2020), namely for mathematics learning carried out in higher education could be utilized blended learning as an alternative and effective strategy. The implementation of blended learning was also an alternative to minimize the problems of conventional learning and designed to facilitate the diversity of students' characteristics (Diana et al., 2020).

IV. CONCLUSION

The conclusion of this study was that the e-module based on blended learning in calculus courses was valid in terms of content and material as well as appearance and presentation and practicality, and in terms of aspects of usefulness, convenience, attractiveness, and efficiency. Thus, it might be utilized by students to learn calculus. Suggestions for future studies are to add video or audio in each material explanation and sample problems to overcome students' challenges to learn. The effectiveness of e-modules based on blended learning in this calculus course could be later conducted to complete this study.

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AUTHORS' BIOGRAPHY

Febria Ningsih, M.Pd.



Born in Kerinci, February 9th, 1990. Lecturer at IAIN Kerinci. Bachelor of Mathematics Education at Universitas Bung Hatta, Padang, graduated in 2011; Master of Mathematics Education Concentration, Universitas Negeri Padang, Padang, graduated in 2014.

Ria Deswita, M.Pd.



Born in Kerinci, December 1st, 1990. Lecturer at IAIN Kerinci. Bachelor of Mathematics Education, Universitas Jambi, Jambi, graduated in 2012; Master of Mathematics Education at Universitas Pendidikan Indonesia, Bandung, graduated in 2015.