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Article

Measuring the Level of Validity of Blended Learning in the Mathematical Economics Course of Management Study Program

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Abstract

This study aimed to develop a blended learning program for mathematical economics course to meet both valid and practical aspects. The Rowntree and the Tessmer formative evaluation model was used in this study to describe three stages of the development process, namely planning, development and evaluation. The participants of this research comprised three experts to review the blended learning program and teaching materials, three students to take the one-to-one evaluation test and 39 students to take the small group evaluation test. Data collection method was the walkthrough method and a questionnaire. At the planning stage, curriculum analysis, analysis of graduate learning outcome and teaching materials were carried out. At the development stage, a design was made using blended learning-based teaching materials which were presented in prototype form through learning management system. At the evaluation stage, validity tests were carried out through self-evaluation and expert judgment activities. Based on the results of self-evaluation and expert judgment, it was found that the learning program and teaching material met the valid aspect. The results of the one-to-one evaluation and small group evaluation were obtained in the practical category. Thus, learning program and teaching material with blended learning approach were found to be appropriate to be used as the teaching material in mathematical economics course. With this developed learning approach, it is hoped that students would develop skills in solving economic problem based on mathematical analysis.

Keywords

Level of Validity, Blended Learning Program, Mathematical Economics

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The mathematical economics course is one of the mandatory courses programmed by students in the management study program of the business economics faculty at the Universitas Muhammadiyah Makassar, Indonesia. The course is designed to assist students in resolving economic issues that arise in their daily lives. As a result, students can use mathematical techniques to analyze economic problems (Lawson, 2012). The series, functions, and multiple differentials approaches are used as the scope and the basic theoretical material of this course. This material is implemented to solve the problems related to economic activities (Hodgson, 2013). Therefore, the learning in this course needs to be addressed to train students' problem-solving skills. This can be done by maximizing all existing campus facilities. One of them is adequate internet facilities to be used as learning media (Sobaih et al., 2016). Through the internet, learning can be done online where this learning is not done completely online but combines face-to-face and online learning known as blended learning (Aspden & Helm, 2004; Larson & Sung, 2009; Mortera-Gutiérrez, 2006; Osguthorpe & Graham, 2003; Picciano, 2006; Rasheed et al., 2020).

Blended learning is a type of learning that mixes conventional learning with contemporary technologies and adapts to the requirements of students (Smaldino et al., 2008). Students have access to additional teaching materials taken interestingly (via the internet), resulting in communication or interaction between teachers and students (SĂMĂRescu, 2016). Blended learning is a learning activity that involves a systematic combination of face-to-face interaction and technology between students, teachers, and learning resources (Bliuc et al., 2007). This statement is supported by Cheung and Hew (2011), explaining that blended learning combines face-to-face learning and online learning. According to Bonk and Graham (2012) suggest that blended learning is a system that combines face-to-face learning and computer-assisted learning where the use of computer-based media is done to help deliver teaching materials.

Implementing the blended learning model makes it possible to create new experiences for students in terms of knowledge, skills, and competencies. Various research results also state that blended learning positively impacts learning. According to Bekele (2010), blended learning model can motivate and increase satisfaction of students in learning process. In addition, the students' conceptual understanding in the material is also felt to be more understood. Furthermore, Ashby et al. (2011), found a significant difference in learning outcomes between students who studied in the traditional learning environment and others who studied in the blended learning. In addition, online learning reduces the dropout rate of students.

Another case with Lopez-Morteo and Lopez (2007) suggests that the electronic learning environment has a positive impact on students' mathematical attitudes. Balacheff and Kaput (1996) suggest that the interactive technology perspective encourages bigger changes in the curriculum and challenges many assumptions about what, when, and where mathematics can be learned by which students. It gives space for researchers to develop learning programs by adopting blended learning model from various studies to be implemented in learning mathematical economics in university. Related to several blended learning studies of blended learning that have been stated previously, some look at student satisfaction, student motivation, student learning outcomes, student performance, student perceptions of blended learning, and the quality of learning with blended learning strategies. In this study, the researchers tried to develop a learning program with a blended learning strategy in one particular subject that meets the valid and practical criteria. This is based on the opinion of Picciano (2006); Richey and Klein (2014); (Visser, 1998); Wu et al. (2010), who suggest that the development of a learning model is said to be good when the learning program meets the valid and practical criteria. In addition, the teaching materials used must also meet these aspects.

Various learning methods are introduced to support a complex learning environment which is expected to increase the professional competence of a lecturer (Lozano et al., 2017; Thai et al., 2017). It is implemented so that the learning process can be held interactively, inspiring, fun, challenging, motivating students to participate actively and providing sufficient space for independence in accordance with the talent and psychological development of students (Syamsuddin et al., 2021). In connection with this, the implementation of the curriculum is important in the stages of implementing education where one of its forms is the actual implementation of the curriculum, namely the learning process both in the classroom and outside the classroom (Butler, 2011).

Many campus facilities can be optimized for use, such as the internet for online learning (Minoli et al., 2017; Muñoz et al., 2020). There are many digital-based learning media developments that make it easier for students to learn independently so as to produce online learning or offline learning. Online learning consists of

media equipped with controllers used by users so that both lecturers and students can access (Kohen-Vacs et al., 2016; Rachmadtullah et al., 2018). The offline media is not equipped with a controller that can be used by students who do not need to be connected to the internet network (Sormanen & Dutton, 2015). However, online learning has problems with direct interaction between students and teachers, however teachers need feedback from students and students also need feedback from teachers (Rasheed et al., 2020; Sepulveda-Escobar & Morrison, 2020).

Although the material is already available online, this learning is still not satisfactory even though the material is already available where students can learn anywhere and anytime (Fonseca et al., 2018; Sadeghi, 2019). However, students also need direct interaction with teachers and peers for direct discussion. Even though online learning is now also equipped with the development of video conferencing and student-to-student webchats, students and teachers need direct interaction with each other. Blended learning is a solution to the weaknesses of online learning because it combines online, offline and face-to-face learning.

One of the virtual high schools located in New York State Putnam/Northern Westchester County BOCES over the last ten years has implemented a blended learning model by paying attention to learning activities through 1) face-to-face instruction in brick-and-mortar classrooms, 2) synchronous instruction in virtual classrooms, and 3) online instruction (i.e. asynchronous) in the learning management system (LMS) (Cunningham, 2021). Cunningham (2021) explained that various activities carried out by teachers to enforce their beliefs in blended learning include centered on active learning. In addition, teachers choose their roles as facilitators, coaches, guides and co-learners. The learning strategy used is also through the selection of various types of learning media that are adapted to the teaching material by involving students. Teachers prioritize authentic assignments and provide opportunities for students to collaborate. In the aspect of assessment, the teacher chooses formative assessment and feedback to see student activity in the learning process and mastery of teaching materials.

Research conducted by Dziuban et al. (2006) that blended learning can improve learning outcomes and can increase student interest in learning compared to full learning using online learning. The use of Information, Communication and Technology (ICT) in education has changed the way of learning from conventional learning or traditional learning prioritizing face-to-face to digital-based learning by utilizing technology and information (Moskal et al., 2013).

Various studies at the faculty or college level on blended learning show that many lecturers are interested in online learning (Jeffrey et al., 2014; Morris et al., 2019). While Bates and Sangra (2011) argue that online learning really needs direct learning to provide feedback between teachers and students. This indicates that learning with technology development with a combination of face-to-face learning can produce a more effective and efficient learning. This learning is balanced between face-to-face and online learning, namely by using multimedia loaded on computer, handphone, video confection and other technological media. Thus, teachers or lecturers with students can communicate even at different distances and places (Alea et al., 2020; Markova et al., 2017). In addition, student learning activities can be equipped with face-to-face learning which allows problems in online learning materials so that there is a discussion and question and answer process to obtain solutions to problems that arise in the previous online learning process.

The concept of hybrid learning which initially combines face-to-face, online and offline learning, has recently turned into blended learning (Dakhi et al., 2020; Nortvig et al., 2018). Blended means a mixture or combination while learning is instruction. Graham (2006) states that blended learning is a combination of various learnings, namely combining face-to-face learning with traditional learning concepts that are often carried out by education practitioners with forms of learning that deliver material directly to students with online and offline learning that emphasize the use of technology.

The concept of blended learning focuses on communication between face-to-face learning meetings and online written communication (Austin et al., 2017; Singh et al., 2021). This learning concept seems very simple but more complex in its use. Therefore, it needs to be done by lecturers who have skills in information and technology so that they can regulate the course of the learning process both online and face-to-face. Thus, the quality of learning can still be controlled both from the aspect of material and learning methods and learning objectives. The principle of blended learning according to Garrison and Vaughan (2013) that this model is an attempt to combine online learning with face-to-face learning. In addition, the teacher involves students in designing their learning and rearranging traditional learning strategies that have been done before (Goodyear, 2015).

Thus, it takes skills to set strategies and design learning in order to apply a learning model so that learning objectives are achieved (Sousa & Rocha, 2019). One of the subjects taught at the Universitas Muhammadiyah Makassar in Indonesia is a mathematical economics course. Mathematical economic is a very important material to be mastered, especially in management lectures. This material is provided as a provision for students to understand various formulas, methods, mathematical methods that will be applied and implemented in problems related to economics as a means of solving them. Given the importance of this material, lecturers' skills are needed in developing designs and properly applying this blended learning model by paying attention to existing aspects related to the development of the material, learning objective and design.

In mathematical economics learning is presented in the form of blended learning by combining various forms of learning tools, for example a combination of online web-based learning programs, online learning videos and other applications that support the learning environment and knowledge management system. By applying the blended learning concept developed by Haking and Syamsuddin (2020), the learning process in the mathematical economics course in this study is explained by the explanation that face-to-face learning activities in class and independently through online learning are guided by lecturers with structured learning.

In its development, the learning program by applying blended learning to mathematical economics courses is formulated with the proportion of online learning 65 percent and face-to-face meetings 35 percent. The development of teaching materials and learning programs needs to be implemented to determine the validity of the intended blended learning strategy. Therefore, in order to be used, the learning program using the blended learning approach needs to be validated. This is done to produce a learning program using a blended learning model that is representative of the learning system, especially in mathematical economics learning so as to increase the credibility of the model. Thus, a learning program using a blended learning approach in mathematical economics courses that is developed and meets valid aspects is feasible to be used as one of the learning programs and teaching material in mathematical economic learning at universities in Indonesia.

Research Methods

- *Research design*

This research aimed to produce a blended learning program in the mathematical economics course for students majoring in management, at Faculty of Economics and Business, University of Muhammadiyah Makassar, Indonesia using research development design. Researchers focused on testing the validity of blended learning program development through the analysis, design and development stages. The learning programs developed are semester learning plans and teaching materials. The development model used in this study was the Rowntree development model and the Tessmer formative evaluation model, which included self-evaluation, expert review, one-to-one evaluation, and small group evaluation.

- *Sampling*

A random sampling technique was used to identify the participants of this research. Three experts from the fields of learning technology, mathematics and economics were selected to review the teaching material. The student participants were selected from those who were pursuing or had competed the mathematical economics courses. There were three students who were selected for one-to-one evaluation and 39 students of one single class for group evaluation test.

- *Research Instruments and Data collection*

Data collection instrument used in this study was the walk-through method. The walk-through method is a data validation technique that involves several experts to evaluate the product as a basis for revising the initial product. The instrument required in this method is a questionnaire in the form of a validation sheet. The validation process was conducted to determine the feasibility of a research instrument, while the validated aspects of the developed learning program were namely material, construction, and language aspects.

- *Data analysis*

The data obtained from the validation results were analyzed using descriptive statistics with quantitative and qualitative descriptive approaches. Determination of the validity value was completed with the following formula.

$$\bar{v} = \frac{\sum_{I=1}^{n} RAi}{n}$$

Description:

$\bar{v}$ = validity average score
RAi = i aspect validation average score
n = many aspects

The results of the average validation score obtained was adjusted to the criteria adapted from Syamsuddin and Mustafa (2021) described in Table 1.

Table 1. *Criteria for categorizing the validity of learning devices*

Score Interval	*Category Validity*
$4 \leq \bar{v} \leq 5$	Very valid
$3 \leq \bar{v} < 4$	Valid
$2 \leq \bar{v} < 3$	Invalid
$1 \leq \bar{v} < 2$	Not valid

The questionnaire results of one-to-one evaluation and small group evaluation were used to test the practicality of the developed prototype. The data obtained through questionnaires were analyzed using a Likert scale to measure student opinions and perceptions on the developed teaching materials, which are described in the Table 2 (El Sadik & Al Abdulmonem, 2021; Haking & Syamsuddin, 2020).

Table 2. *Questionnaire score category*

Score	*Category Validity*
5	Strongly agree
4	Agree
3	Disagree
2	Do not agree
1	Strongly disagree

Data from the questionnaire were presented in tabular form, using the percentage calculation method and the following formula.

$$\% = \frac{N}{Si} \times 100\%$$
$$Si = Sm \times n$$

Description :

N = total answer score for each item
Si = total of item's ideal score
Sm = total of maximum score
n = many samples

The data was further analyzed using a Likert scale to measure students' responses to the learning tools, which are described in Table 3.

Table 3. *Categories of responses to learning tools*

Score Interval (%)	*Category Validity*
$85 - 100$	Very practical
$69 - 84$	Practical
$53 - 68$	Practical enough
$37 - 52$	Not practical
$20 - 36$	Not very practical

Results

The validation results of the development of the mathematical economics learning program obtained in this study were intended for students majoring in management at the University of Muhammadiyah Makassar, Indonesia. This was followed by the conduct of development research using the Rowntree development model and the Tessmer formative evaluation model, including self-evaluation, expert review or expert judgment, one-to-one evaluation, and small group evaluation. This learning program was developed in 3 (three) stages in the development process, namely planning, development, and evaluation stages. Each of these stages is described in more detail.

- *Planning Stage*

At this stage, researchers conducted an analysis which included curriculum analysis, analysis of learning outcomes, and measuring graduate learning outcomes. In addition, a map of lecture material as a form of analysis of teaching materials was also constructed based on the characteristics of the material, students' needs and the learning environment. Curriculum analysis activities included mapping of general material in mathematics courses, namely (1) the characteristics of economics and business mathematics; (2) basic concepts of mathematics and business economics; (3) functions in economics and business; (4) financial mathematics; (5) calculus algebra. These materials were then developed as teaching materials for one semester. In the analysis of learning outcomes, an illustration was obtained where this learning program was expected to develop students' abilities in understanding algorithms in financial calculations and mathematical economic problems. Thus, it is hoped that this course would prove as one of the tools to solve economic problems quantitatively with a mathematical approach.

Some of the basic mathematical concepts developed were explained to the students so that they could solve mathematical problems in economics. They could use these skills to solve basic economic problems. Some of the topics developed included the mathematical properties of economics and business; economic models; linear functions; system of linear equations; application of linear functions; non-linear functions; application of non-linear functions; exponential and logarithmic functions; application of exponential and logarithmic functions; sequence and series; application of functions and series; differential calculus: a function with one independent variable; optimization: a function with one independent variable; application of differential calculus: a function with one independent variable; and so on. Each material presented was equipped with other components such as competencies and learning objectives to be achieved from each material to be presented. In addition, it was necessary to pay attention to the structural aspects of each material described, of course with an emphasis on the formulation of basic competencies, the determination of evaluation or assessment tools, the presentation of material adapted to learning indicators.

- *Development Stage*

At this stage, a preliminary study was conducted regarding the characteristics of students, materials, and learning environment. The development of learning programs in mathematical economics courses was expected to accommodate differences in students' characteristics. The development of learning programs was based on the requirements of universities, in this case, it was the University of Muhammadiyah Makassar, Indonesia. The university was already witnessing digitalization and efforts could be made to develop learning programs by integrating computer science in online learning, to initiate the blended learning methods of teaching. The blended learning program in the mathematical economics course was chosen because this course implemented mathematics in problems related to economic activities as a solution. In this regard, mathematical economics was a very important subject for students to provide them with problem-solving skills related to their future world of work (Diep et al., 2017; Kohen-Vacs et al., 2016; Likert, 1932). The application of blended learning must pay attention to the right time composition so that the learning objectives are achieved maximally. McGinnis (2005) suggests that the time allocation can start with the initial 75:25 formulae: namely, 75% of the time is used for online learning and 25% for face-to-face learning. Meanwhile, Uğur et al. (2011); Wannapiroon (2008); Wu et al. (2010) suggest that blended learning has an online learning composition of 30:70 related to the proportion of content delivered online. In addition, the characteristics of blended learning have a larger portion of online learning than face-to-face. Based on this explanation, the composition of face-to-face learning should be 35%, and online learning 65%. This formulation was applied in mathematical economics learning to identify the level of validity of the developed blended learning program (Smith & Hardaker, 2000; Sobaih et al., 2016; Sormanen & Dutton, 2015).

Based on the description above, a learning program design was made using blended learning-based teaching material. This stage aimed to prepare prototypes of teaching material or lecture material in learning mathematical economics. Through a learning management system (LMS) developed by the campus where learning management is integrated online through an online learning system application found on the portal https://spada.unismuh.ac.id/. The developed material consisted of 15 topics that were taught for 1 (one) semester. In the following figure (Figure 1), the results of the development of the learning program are presented.

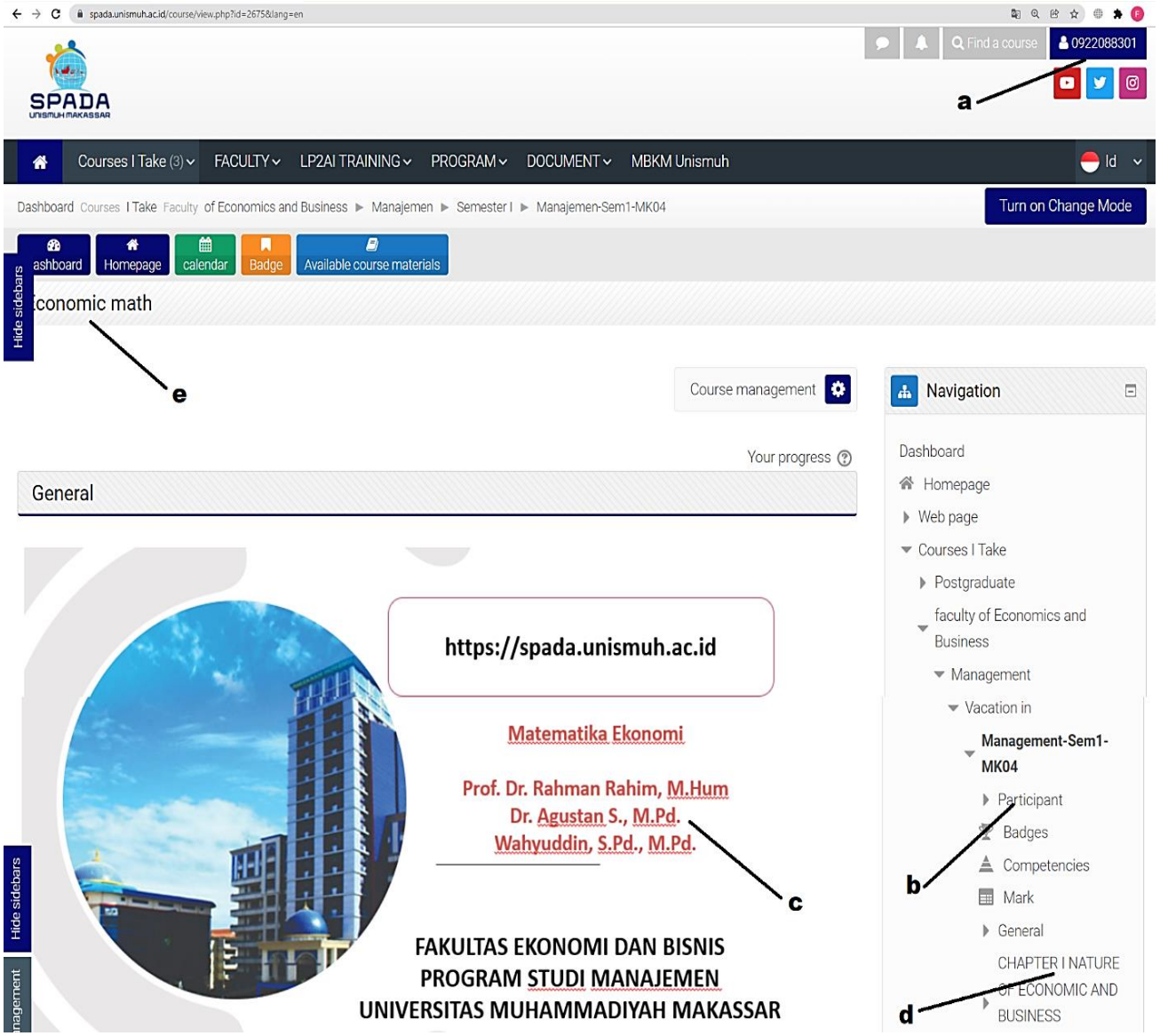

Figure 1. *The identity display of the mathematics economics course*

In the menu section (a) is the login menu. In this menu, each lecturer or student can log in using their respective identification numbers according to the rules set by the campus. Both students and lecturers already have their user IDs that are used to log in. The menu (b) comprises information related to programming mathematical economics courses. This menu contained all student activities related to the lecture program, starting from filling out the attendance list and collecting assignments and task reports, individual and group assignments. The menu (c) gives a team of developers and lecturers responsible for the material and implementation of learning for the course. The menu (d) is a topic menu that contains a list of topics to be taught every week, which consists of 15 topics. Some of the topics that will be covered include the mathematical properties of economics and business; economic models; function; linear function; system of linear equations;

application of linear functions; non-linear function; application of non-linear functions; exponential and logarithmic functions; application of exponential and logarithmic functions; sequence and series; application of functions and series; differential calculus: a function with one independent variable; optimization: a function with one independent variable; application of differential calculus: a function with one independent variable. Finally, on the menu (e) is the identity or name of the course, namely economics mathematics.

Furthermore, in different sections, other menus have their respective functions. Figure 2 provides a screenshot of the menu section.

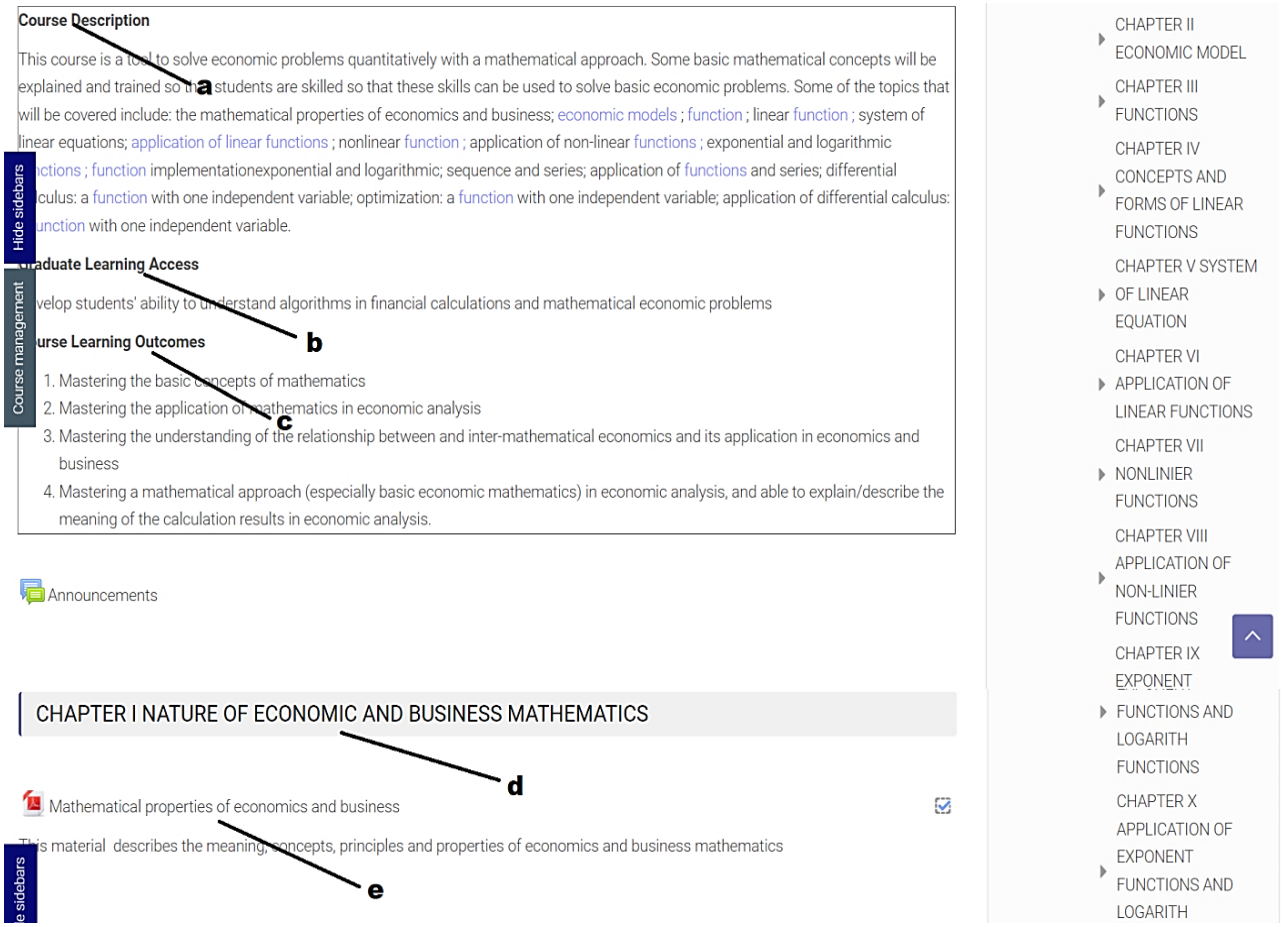

Figure 2. *Display of the core materials for the mathematics economics course*

The picture (Figure 2) describes in part (a) the course description, which is a general description of the courses that are presented to students in the learning process for one semester. The menu for part (b) is that graduate learning outcomes are abilities obtained through internalization of knowledge, attitudes, skills, competencies, and accumulated work experience from students for one semester. Part (c) the learning outcomes of the courses are the achievements of learning that cover all aspects of attitudes, skills, and knowledge. The menu section (d) is the material or topic to be studied. This material consists of 15 subtopics discussed or presented to students. Finally, in the menu section (e) is a file of material that will be presented to students and can be downloaded for re-study by students (Sepulveda-Escobar & Morrison, 2020; Smaldino et al., 2008).

- *Evaluation Stage*

At this stage, an evaluation process was conducted where the material developed based on blended learning was tested for validity through self-evaluation and expert judgment activities. In addition, it was conducted to obtain information about whether or not the material developed can be used in the learning process or not. Thus, this stage aimed to produce valid blended learning-based teaching materials. This procedure involved a few stages.

Stage 1: Self Evaluation

The self-evaluation was conducted by assessing oneself against the prototype of the learning program in the form of teaching materials that have been developed. This activity can be in the form of self-checking the developed material related to the construct, language, and content that was sought to have fulfilled the valid aspect, which is correct.

Stage 2 : Evaluation

The next stage is the evaluation stage when an assessment is done of the material to ensure that it is developed in accordance with the requirements of the learning program and materials developed. Table 4 summarizes the results of self assessment.

Table 4. *Recapitulation of self-assessment results*

Aspect	***Assessment recapitulation***
Content/material accuracy	3.95
Element of Language	4.55
Design of teaching materials	3.25
Average	3.92
Category	Valid

Based on the results in Table 4, it was clear that the learning program and teaching materials were in the valid category and a further assessment stage can be carried out.

Stage 3 :Expert judgment

At this stage an assessment is carried out regarding the learning program and teaching materials that have been developed by the validator. This validation process involves 3 validators, each of whom is an expert in the field of evaluation or assessment, mathematics and economics. The three validators review aspects that become indicators in terms of assessing the developed product. The aspects in question are the accuracy of the content, linguistic elements and assessments related to the design aspects of the developed teaching materials. The results of the assessment of the validator are presented in Table 5.

Table 5. *Validator assessment results*

Aspect	***Assessment recapitulation***
Content/material accuracy	4.05
Element of Language	4.15
Design of teaching materials	3.25
Average	3.81
Category	Valid

Several elements were received as inputs from the validator, namely a clearer description was needed to present the subject's learning outcomes; that the material should be adjusted to the learning outcomes of graduates; and so on. This has been adjusted by describing the learning outcomes of the courses in more detail, where the decomposition process was based on the learning outcomes of graduates. In addition, some sentences used the local language (cultural bias). It was accomplished by creating and writing phrases using normal language, and it was generally simple to comprehend.

Stage 4: One to one and group evaluation stage

Furthermore, a one-to-one evaluation stage and a small group evaluation were carried out to see the practicality of the teaching materials that had been developed through the provision of questionnaires to students. It was done to measure the opinions and perceptions of students related to learning programs and teaching materials based on blended learning that had been developed. In the one-to-one stage, three students were selected to overview the prototype being developed. In group evaluation, 39 students were selected to provide their responses regarding blended learning-based learning materials and programs.

Table 6 presents the analysis results related to filling out student response questionnaires from the prototype that was developed.

Table 6. *Respondents' assessment results and responses*

Observed aspects	***Evaluation Form***	
	One to one (%)	*Small group (%)*
Attractive display design	80	78.46
Use of fonts: type and size	86.67	84.61
Information clarity	80	80.51
Lecture material is stated clearly	86.67	86.67
Ease of accessing information	86.67	87.69
Learning steps are described systematically and clearly	80	81.53
Clarity of pictures, graphs, tables, diagrams	80	82.56
Motivation to study the material	80	81.02
Not using the local language (cultural bias)	80	81.53
Use of language that is in accordance with Indonesian rules	86.67	84.61
Use communicative language	80	81.53
Time allocation in the learning process is well regulated	93.33	92.82
Learning tools support to achieve learning objectives	66.67	68.20
Learning resources are relevant to the material	86.67	87.69
Use of punctuation in writing is clear and correct	93.33	93.33
Use of mathematical terms in writing is correct	93.33	91.79
Average	83.75	84.03
Category	Practical	Practical

Table 6 clearly states that the results of the evaluation carried out on a one-to-one basis and in a small group meet the practical aspects of the learning programs and materials developed based on blended learning. The average of the two technical evaluations is 83.75 and 84,03 respectively. Thus, the blended learning-based learning program and materials developed are valid and practical. They are appropriate to be used as teaching materials in mathematical economics courses (Nieveen, 1999; Selim, 2007).

Discussion

Based on the findings and its analysis, it can be stated that learning programs and teaching materials in mathematical economics courses using a blended learning approach can motivate students and that this aspect meets the practical aspects of students' responses. It is in line with the results of Bekele (2010), which states that blended learning models can motivate students in learning and increase students' satisfaction in participating in learning. In addition, Lopez-Morteo and Lopez (2007); Lozano et al. (2017) also suggested that motivation arises because it is supported by an electronic learning environment that positively impacts students' mathematical attitudes. Therefore, a campus environment is needed that can support the learning process using a blended learning approach.

By implementing the government regulation of the Republic of Indonesia Number 32 of 2013, where universities optimize all campus environment facilities, it can provide space for students to participate more actively in learning which can provide opportunities for them to be creative in understanding the mathematical economic material being taught (Syamsuddin et al., 2021; Syamsuddin & Mustafa, 2021). One of the campus facilities that can be used as a learning medium is the internet (Selim, 2007; Smith & Hardaker, 2000; Sobaih et al., 2016). Through the internet, learning can be done online where this learning is not done entirely in online form but combines face-to-face learning with online which is known as blended learning (Aspden & Helm, 2004; Larson & Sung, 2009; Mortera-Gutiérrez, 2006; Muñoz et al., 2020; Osguthorpe & Graham, 2003; Picciano, 2006; Rachmadtullah et al., 2018). Thus, through blended learning, campus facilities such as internet services and computer laboratories can be used optimally to improve the quality of the learning process both in the lecture hall and outside the lecture hall.

The blended learning program makes it easier for students to access information (Jeffrey et al., 2014; Uğur et al., 2011). Students have the right to access information supported by campus facilities. In addition, blended learning can improve the performance of students' perceptions as a responsibility in mastering and solving problems independently of existing tasks (El Sadik & Al Abdulmonem, 2021; McGinnis, 2005; McLaughlin et al., 2015; Owston et al., 2013). Thus, students feel satisfied with their performance in the learning process, which impacts their learning achievement (Diep et al., 2017; Nortvig et al., 2018; Wu et al., 2010). In order to achieve this goal, a learning program with blended learning-based teaching materials is needed that meets valid and practical aspects (Nieveen, 1999; Richey & Klein, 2014; Visser, 1998).

Learning program using a blended learning approach is needed in order to increase students' learning independence in mathematical economics course. Thus, students have independent provisions in understanding mathematical concepts in their various uses as a method or mathematical method used in finding solutions to any problems related to the field of economics. Therefore, the autonomy of students' learning in understanding teaching materials independently depends on the skills of the lecturers in developing learning programs and teaching materials using a blended learning approach. In addition, the use of campus internet facilities can be maximized as a learning environment for lecturers in order to make it easier for them to find, access and process information related to the teaching materials that will be developed. Thus, it takes lecturers who are creative and innovative in developing learning programs and teaching materials in mathematical economics courses so that learning programs with a blended learning approach can be used as one of the learning programs that can be used by lecturers in order to increase student learning independence which has an impact on increasing students' achievement learning in mathematical economics course.

Conclusion

This research illustrates that valid learning program and teaching materials are needed to create an independent learning atmosphere for students who use a blended learning approach. From the results of the study, it can be concluded that a learning program using a blended learning approach is needed in order to increase students' learning independence in mathematical economics courses. The results of the development of this blended learning program have met the valid aspects, but in the validation process it does not involve teaching material experts in the field of mathematical economics education. Therefore, the quality of teaching materials developed in the field of mathematical economics still needs to be constructed from the content aspect by the expert team of mathematical economic teaching materials.

Campus internet facilities are sometimes unstable which disrupt the learning process. As a result, students cannot often follow the online learning process properly which causes them to lag behind in material or often they do not get a detailed explanation regarding the material they must master. In addition, there are still students who have not mastered the use of technology which makes these students need assistance in operating the existing system in online learning. From the limitation or weaknesses that exist in this study, the researchers recommend maximizing the existing internet facilities on campus to develop blended learning program. The blended learning program is as an alternative solution to overcome the weaknesses of online learning and face-to-face learning to produce a series of learning that is effective, efficient and fun for students while still referring to existing learning theories. Not only that, the development of learning programs with a blended learning approach can be developed by paying attention to aspects of student problem solving skills related to contextual mathematical economics in everyday life. In addition, lecturers or students who are still not technology literate can be taught by including training in the application of technology. The government can also play an active role by investing in technology so that improving the quality of education in Indonesia can be realized.

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