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Designing Blended Learning Program for Mathematical Economics Using Integrative Learning Design Framework Approach

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ABSTRACT

The development of a blended learning approach is essential in order to effectively address the needs of both online and face-to-face learning environments. The objective of this work is to create a prototype for integrated learning in the field of mathematical economics. The implementation of a blended learning strategy in the construction of a learning program is facilitated by the utilization of the Integrative Learning Design Framework (ILDF) model. This model encompasses three distinct stages, namely exploration, enactment and evaluation. This study comprises a team of three individuals who possess expertise in the domains of instructional materials, educational media, and information technology. In order to assess the feasibility of the proposed learning design, a questionnaire was administered to a sample of 40 students, who were requested to complete it. The questionnaire encompasses an assessment of the preparedness of facilities and infrastructure, the development of teaching materials and media prototypes, and the evaluation of student replies. The findings indicated that the proportion of student answer scores attained a value of 83.75%, falling inside the practical category. Therefore, the created learning design can serve as an alternate approach for teaching economics mathematics, promoting increased student autonomy in the learning process. Thus, it provides students the chance to develop self-reliance in understanding and addressing economic issues using a mathematical problem-solving approach that integrates mathematical concept. Furthermore, it is crucial to explore alternative approaches to blended learning across different academic fields and strive to foster not only problem-solving skills but also the ability to recognize and make connections with students' metacognitive capabilities.

Keywords: [blended learning, design learning, ILDF model]

INTRODUCTION

The field of mathematics education is designed to equip students with the necessary skills and knowledge to effectively address challenges encountered in contemporary society. This framework demonstrates that students are required to possess a range of skills, knowledge, and expertise, as well as the ability to work independently. This encompasses a combination of topic knowledge, specialized skills, expertise, and competency. In accordance with Article 19 of Regulation No. 32 of 2013, the educational units are required to conduct the learning process in an interactive manner that fosters inspiration, enjoyment, and challenge. This approach aims to motivate students to actively engage in the learning process and allows for ample opportunities for the exercise of initiative, creativity, and

independence. Furthermore, the educational units are expected to cater to the diverse talents, interests, and physical and psychological development of the learners. Therefore, the effectiveness of mathematics education can be enhanced by adhering to the guidelines outlined in Ministerial Regulation no. 32 of 2013, which emphasizes the incorporation of mathematical concepts and their practical applications in daily life.

In the contemporary era of digital technology, the utilization of mathematics as a programming language has proven to be both successful and efficient. This suggests that the incorporation of computer science into mathematics education has the potential to enhance student outcomes, including improved performance in mathematics and enhanced computer abilities among students (Owolabi et al., 2014; Weintrop et al., 2016). In addition to its significance in the realm of computer science, mathematics also plays a crucial role in the subject of economics (Mariotti, 2021; Syamsuddin, 2019). Within the realm of economics, the application of mathematics is commonly referred to as mathematical economics (Lafuente-Lechuga et al., 2020). Economic mathematics is a scientific discipline employed as a methodological framework for the examination of economic analyses (Lawson, 2011).

Mathematical economics is a course offered at the Faculty of Economics and Business (FEB) at Universitas Muhammadiyah Makassar. This course aims to equip students with knowledge of mathematical formulas, methods, and approaches that can be applied to address economic problems and provide solutions. This course focuses on the application of mathematical principles to address economic problems. It encompasses fundamental mathematical theories such as series, functions, differentials, differential multiple functions, and matrices, which are utilized to analyze and solve economic issues.

The field of economic mathematics is of considerable significance to students since it provides them with problem-solving abilities that have direct relevance to their prospective career pursuits. The primary objective of the execution of PP No. 32 of 2013, which is also referred to as Peraturan Pemerintah RI Nomor 32 Tahun 2013, is to improve the infrastructure and amenities within the campus environment with the intention of promoting more student participation and involvement in the educational process. This initiative provides students with the opportunity to showcase their ingenuity in their understanding of economic mathematics subjects being taught. The potential of the internet as a learning resource within campus facilities has been recognized (Sobaih et al., 2016). The internet plays a vital role in enabling the integration of online learning, a pedagogical approach that combines traditional in-person teaching with digital elements, also known as blended learning (Cronje, 2020).

The successful integration of blended learning requires a thoughtful evaluation of the most appropriate schedule to ensure the required educational objectives are properly achieved. Jooss et al., (2022) propose that an optimal strategy for time allocation could entail an initial distribution ratio of 75:25. This ratio involves devoting 75% of the designated time to online learning and assigning the remaining 25% to in-person learning. In the study conducted by Müller and Mildenberger (2021), the authors put out the notion that blended learning comprises a variety of instructional methodologies, wherein the online learning component constitutes a proportion ranging from 30% to 79% in relation to the overall delivery of information. Furthermore, blended learning is distinguished by a heightened focus on online learning in comparison to traditional in-person training. Based on the given elucidation, the ratio of in-person instruction amounts to 35%, whilst remote instruction comprises 65% of the whole composition. The present study

aims to use this methodology within the domain of economic mathematics education, with the purpose of evaluating the extent to which the specified blended learning program is valid, practical, and effective.

Blended learning, also known as hybrid learning, is an instructional strategy that combines traditional educational techniques with modern technological resources to meet the different learning needs of students (Ashraf et al., 2022; Shevchenko et al., 2022). Sămărescu (2016) posits that pupils are furnished with additional educational materials which are disseminated via online platforms. This strategy promotes active participation and enables communication and collaboration between educators and learners. Blended learning is an educational methodology that involves the intentional incorporation of face-to-face interaction and electronic resources within the context of student-teacher dynamics and instructional materials (Singh et al., 2021).

According to Li et al. (2021), blended learning is an educational methodology that integrates conventional face-to-face teaching with online learning components. In their recent study, Li et al. (2021) put forth a proposition for a blended learning strategy that combines online and face-to-face instructional methods. This pedagogical approach entails the online dissemination of a significant quantity of course materials, often facilitated by virtual discussions, supplemented by occasional face-to-face meetings. According to Nikolopoulou (2022), there is evidence supporting the claim that blended learning involves the integration of conventional face-to-face teaching methods with digital-based learning approaches.

Bonk and Graham (2012) define blended learning as an educational methodology that combines conventional in-person instruction with computer-based learning. The approach involves the utilization of computer-based media to facilitate the distribution of educational material. The implementation of this pedagogical strategy facilitates the integration of online educational resources, specifically those that can be accessed via the internet, while still preserving face-to-face contacts. According to Rodríguez and Pulido-Montes (2022), this particular strategy provides students with a diverse array of educational materials.

The use of the blended learning paradigm has promise for creating innovative educational prospects for students, including the acquisition of knowledge, skill development, and the fostering of competencies. Multiple research studies have also demonstrated that blended learning produces favourable outcomes in the educational process. Prifti (2022) asserts that the use of a blended learning methodology has demonstrated the capacity to augment student motivation and pleasure within the educational experience. Moreover, it has been observed that students are more likely to perceive a deeper understanding of the subject matter when they actively participate in learning procedures, rather than relying on passive methods like memorization and note-taking. Lane et al. (2021) have recognized blended learning as a desirable technique for evaluating student satisfaction, learning effectiveness, and lecturer satisfaction. Furthermore, the research conducted by Martin et al. (2022) unveiled a statistically significant discrepancy in academic accomplishments between students who were involved in conventional educational environments and those who took part in blended learning methodologies. Moreover, it is important to acknowledge that online learning has been shown to have a beneficial effect on reducing student attrition. Furthermore, Chisadza et al. (2021) have put up the proposition that students who participate in conventional classroom-based training have diminished levels of academic attainment.

According to a study conducted by Moreno et al. (2020), the use of electronic learning platforms shown a positive impact on students' attitudes towards mathematics. The

positive impact of promoting motivation among students has the potential to increase the learning process. Quinn and Aarão (2020) argue that the integration of interactive technology in education necessitates substantial changes to the curriculum and challenges conventional notions about when, where, and for whom mathematical instruction should be provided. This presents a potential avenue for researchers to develop educational programs by integrating blended learning models derived from various studies, with the aim of applying them in the instruction of economics mathematics at the university level.

Page et al. (2017) conducted a study to evaluate the effectiveness of blended learning through an assessment of its overall quality. The results of their study revealed a noteworthy association between students' positive evaluations of the quality of online instruction and their level of involvement, as well as their achievement of relatively higher scores. Furthermore, blended learning is utilized as an additional method to augment the conventional in-person learning experience. The utilization of online learning has become an essential aspect of the student's educational journey in distant settings, and it is increasingly acquiring a prominent position in the traditional on-campus student experience. This implies that students possess the capacity to employ web/blog-based learning tools in various educational environments, including both on-campus and off-campus contexts.

Gagnon et al. (2020) assert that blended learning/hybrid programs consist of a varying proportion, ranging from 30 to 79 percent, of program content delivered via online platforms. Blended learning is characterized by the incorporation of both conventional in-person teaching and online learning, with a variable allocation ranging from 30% to 79%. Blended learning is an educational methodology that combines the use of online platforms for delivering instructional information with traditional in-person teaching methods. A considerable proportion of the course content is distributed via online platforms, commonly through online discussions, complemented by occasional face-to-face gatherings.

In relation to previous studies on blended learning, various aspects have been examined, including student satisfaction, motivation, learning outcomes, performance, perceptions, and the quality of learning. In this particular study, the researchers aimed to design a learning program using a blended learning strategy for a specific subject, ensuring its validity, practicality, and effectiveness. The aforementioned viewpoint is derived from the works of Plomp & Nieveen (2007), Richey & Klein (2014) and Visser (1998), who suggest that the efficacy of a learning model is contingent upon its adherence to the criteria of validity, practicality, and effectiveness. Furthermore, it is imperative that the educational materials employed adhere to these three dimensions as outlined by Nieveen (1999).

The development of this blended learning program will be applied to the economics mathematics course in the management study program which provides competence to students to be able to analyze and solve cases on economic problems in general and company and project problems in particular, with a variety of known mathematical theories and formulas so that students are expected to be able to solve problems based on analysis and mathematical calculations.

The implementation of this blended learning program will be utilized in the economics mathematics course within the management study program. This program aims to equip students with the necessary skills to analyze and resolve economic issues in a broad context, as well as specific problems related to companies and projects. By incorporating various established mathematical theories and formulas, students are expected to develop the ability to solve problems through analytical thinking and mathematical calculations.

Referring to the Research Master Plan (RMP) of the Universitas Muhammadiyah Makassar, this research tries to develop a learning model in university based locally, namely blended learning with the aim of helping students to solve economic problem critically and creatively where economic mathematics is used as an alternative solution. Although the learning program developed is in the form of blended learning, face-to-face meetings are maintained. Therefore, it is necessary to combine online and face-to-face learning which refers to the proportions namely 35% face-to-face learning and 65% online learning.

Presently, numerous educational establishments, particularly universities, are at the forefront of pioneering and advancing internet-based learning modules in order to complement the traditional education system. Nevertheless, innovation inevitably entails both advantages and disadvantages. Hence, it is imperative to engage in the examination, investigation, and advancement of e-learning modules. This research aims to provide a comprehensive analysis of integrative learning design for online learning, commonly referred to as the Integrative Learning Design Framework (ILDF). This study endeavors to create a blended learning curriculum that will be implemented in mathematics and economics courses, taking into consideration the availability of facilities and infrastructure, as outlined in the preceding context.

This course equips students with the necessary competences and skills to effectively manage and govern the fundamental concepts underlying basic social demands. The pursuit of economics education can cultivate an individual's social consciousness and foster a sense of prudence and resourcefulness. The study of economics can equip individuals with the skills necessary to effectively and judiciously govern and manage nominal values. Hence, the inclusion of this subject is crucial for students as it equips them with the necessary knowledge of mathematics as a means to assess economic models and address real-world issues. For instance, the tasks involved in this context encompass the determination of selling prices, calculation of profits and losses, assessment of loan interest, computation of taxes, and other related activities. Furthermore, this course offers direction and support in the management and evaluation of business and development strategies, regardless of their scale, whether it small, medium, or large. This course offers opportunities for conducting economic analysis. The utilization of mathematical symbols and ideas is a fundamental aspect of problem-solving, with mathematical models serving as a prevalent analytical strategy across several scientific disciplines.

MATERIALS & METHODS

The aim of this study is to undertake developmental research in order to construct a blended learning curriculum tailored to students who are pursuing a management degree with a focus on mathematical economics courses. The incorporation of blended learning into educational curricula entails the application of the Integrative Learning Design Framework (ILDF) paradigm from Dabbagh and Bannan-Ritland (2005) which covers three discrete stages: exploration, enactment, and evaluation which is described as follow.

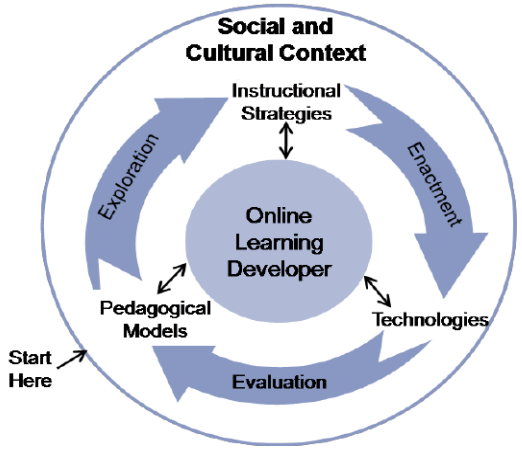

Figure 1. Model of Integrative Learning Design Framework (ILDF)

The paradigm discussed above can be described as a constructivist instructional design model implemented inside school

settings, which offers a systematic method for developing online learning resources. This approach integrates innovations in instructional design that are specifically customized for upcoming learning processes, such as network-based learning, including online learning or web-based learning, which efficiently utilize communication technology. According to Dabbagh and Bannan-Ritland (2005), the Integrative Learning Design Framework concept is applicable in many online learning contexts, including the development of electronic courses for higher education.

Sample

During the implementation of the blended learning program, a total of 120 students participated, out of which 40 students were enrolled in the mathematical economics course. The sample selection was conducted by the utilization of simple random sampling, as all pupils possessed an average cumulative predicate index score falling within the good category. In addition, students possess comparable proficiencies in computer utilization due to their enrolment in computer courses, which equip them with the necessary abilities for operating computers.

This study entails the collaboration of three individuals who possess expertise in the domains of instructional materials, educational media, and information technology. Their collective aim is to obtain a comprehensive understanding of a legitimate educational program. In order to assess the feasibility of the proposed learning design, a questionnaire was administered to a sample of 40 students, who were requested to complete it. The questionnaire encompasses an assessment of the preparedness of facilities and infrastructure, the development of teaching materials and media prototypes, and the evaluation of student replies. The development process encompassed an initial exploration stage, during which an assessment was conducted to evaluate the current state of campus facilities and infrastructure in relation to internet network-based resources. Additionally, an evaluation was conducted to gauge the proficiency of lecturers in utilizing internet and computer facilities, as well as the preparedness of students for online-based learning. This statement serves as a valuable resource in the advancement of blended learning. During the preparatory phase, the development of a product involves incorporating the outcomes from the preceding exploratory stage. This integration takes the shape of a blended format learning design, prototype learning media and resources, and a comprehensive blended learning program. Moreover, during the evaluation phase, an assessment or expert review is conducted to evaluate the learning materials and media that have been generated, as well as the outcomes of individual responder trials pertaining to the materials and media employed in the learning procedure.

Exploration Stage

At the exploration stage, an analysis consisting of:

1. The analysis of student needs encompasses various factors, including student characteristics, the preparedness of campus facilities and infrastructure, lecture tactics, and the utilization of learning technologies.
2. The analysis of lecture material involves considering the competences required to fully comprehend the course and the abilities necessary to comprehend, master, and address difficulties within the context of the lecture material.
3. The situational analysis is conducted to assess the existing state of affairs on campus about the preparedness of facilities and infrastructure for internet network-based resources, the proficiency of lecturers in utilizing internet and computer facilities, and the readiness of students for online-based learning.

Preparation Stage

In the preparation stage, the researcher carried out the activities described as follows.

1. Compile a selection of reference books pertaining to the subject matter covered in the lecture, with the intention of incorporating them into either online or in-person educational resources.
2. Create a comprehensive assessment of the requirements for the advancement of educational programs by considering the frequency of interactions during lectures to ascertain the relative distribution of online and face-to-face (F2F) meetings, based on the allocation of instructional content intended for students.
3. The development of a blended learning design involves careful consideration of several key elements, including the definition of fundamental competencies (such as graduate learning outcomes and subject learning outcomes) that students are expected to acquire, the design of appropriate media, the preparation of instructional materials, and the selection of evaluation methods to be used throughout the lecture process.

Evaluation Stage

At this stage, a blended learning program was developed which was based on the results of validation by expert validators and phase I product revisions. The development steps are described as follows:

1. The primary offering is presented in the format of electronic media, specifically web integrated learning.
2. The components found in electronic media include: (a) a cover page that displays the course title, lecturer's name, course identity, and relevant images; and (b) the course content, which encompasses course descriptions, course achievements (CP-MK), course study materials, descriptions of course materials for each Sub-CP-MK, online lectures accompanied by indicators and evaluation/assessment methods, as well as assignments and quizzes for each lecture material.
3. Evaluation involves the examination of the blended learning program that has been created during the implementation phase, followed by the revision of the program's second stage in response to the evaluation findings obtained during the trial period. During the evaluation phase, the acquired data is examined in order to identify necessary modifications and assess the suitability of the generated product for its intended usage.

RESULT

The researchers employed the Integrative Learning Design Framework (ILDF) model to examine the feasibility of implementing a blended learning program. This investigation involved a three-stage process, which encompassed exploration, preparation, and evaluation. The subsequent passage provides an account of the creation process of a blended learning program utilizing the Integrative Learning Design Framework (ILDF) methodology.

Result of Exploration Activities

The analysis of student needs is conducted by considering various factors, including student characteristics, the preparedness of campus facilities and infrastructure, lecture tactics, and the utilization of learning media. In this context, students require online learning resources to facilitate convenient and comprehensive access to educational material, hence enhancing their understanding of the subject matter. The course on economics mathematics requires students to comprehend and engage with a substantial amount of complex material over the course of one semester. It is essential for students to approach this material in a gradual and sequential manner, starting with more accessible concepts and progressing towards more intricate ones. Consequently, students may require guidance from their instructors in terms of accessing the material and utilizing appropriate media resources. Additionally, they are engaged in the development of practice questions and problem-solving exercises pertaining to the field of economic mathematics, which are currently being incorporated into their programming efforts. Hence, the implementation of a mixed learning approach, specifically through the

utilization of the SPADA website (an online learning system offered by the institution), is imperative.

The examination of lecture content entails the evaluation of the skills needed to completely grasp the course topic, as well as the capabilities required to comprehend, master, and tackle challenges within the lecture's environment. In the present context, through an analysis of the lecture materials, it is apparent that students are expected to improve their ability to understand algorithmic problems pertaining to financial calculations and mathematical economic obstacles. Therefore, the choice of subject matter was motivated by the necessity to acquire knowledge, with this specific course functioning as a method to examine economic issues using a quantitative and mathematical approach. The objective of this educational module is to clarify and develop key mathematical concepts, enabling students to acquire the essential skills to properly tackle basic economic challenges. The course will cover a range of topics including the mathematical principles that underlie economics and business, economic models, functions, linear functions, systems of linear equations, the practical application of linear functions, nonlinear functions, the practical application of nonlinear functions, exponential and logarithmic functions, the practical application of exponential and logarithmic functions, sequences and series, the practical application of functions and series, differential calculus for functions with one independent variable, optimization for functions with one independent variable, and the practical application of differential calculus for functions with one independent variable. Therefore, it may be stated that the subjects to be elaborated upon are as follows:

1) Mathematical properties of economics and business
2) Basic concepts of mathematics and business economics
3) Functions in economy and business
4) Financial math
5) Algebra calculus

The situational analysis is conducted by considering the current state of affairs on campus, particularly in relation to the preparedness of facilities and infrastructure for internet-based services, the proficiency of lecturers in utilizing internet and computer facilities, and the readiness of students for online learning. Universities have implemented an online learning system website, accessible at spada unismuh.ac.id, which serves as a platform for the development of educational programs pertaining to many courses, including the economics mathematics course. This website offers a range of functionalities that enable users to post teaching materials for an entire semester. Additionally, it supports the presentation of multimedia content, such as learning films, and provides numerous features aimed at the development of learning programs. The subsequent content presents a rudimentary illustration of a straightforward website for Unismuh Spada, which will afterwards undergo significant enhancements pertaining to tactics, materials, and learning mediums employed to facilitate students' thorough understanding of the subject matter.

Result of Preparatory Activities

The preparation of the learning program design is as follows.

Compile a selection of reference books pertaining to the subject matter of the lecture, with the intention of incorporating them into either online resources or traditional classroom materials. Currently, academics are investigating various materials that might serve as valuable references for the development of teaching materials in economics mathematics courses, with a particular focus on the management study program. The purpose of this activity is to gather educational resources for a single semester within the present academic year. Create a comprehensive assessment of the requirements for the advancement of educational programs by considering the frequency of meetings during lectures to

ascertain the relative distribution of meetings through online learning and face-to-face interactions (F2F), based on the allocation of lecture content intended for students.

The determination of the percentage of face-to-face and online learning sessions will be based on considerations such as the features of the material and students, as well as the students' readiness to receive the instructional materials being addressed. In the context of higher education, researchers endeavor to construct a regionally-focused instructional framework in the form of blended learning. The primary objective of this approach is to facilitate students in their critical and creative resolution of economic issues, employing economic mathematics as a viable alternative option. Despite the utilization of a blended learning approach, the learning program in question still incorporates face-to-face interactions. Hence, it is imperative to integrate both online and face-to-face instructional modalities, with the former comprising 65% and the latter being 35% of the overall learning experience.

The development of blended learning instructional designs involves careful consideration of several key components, including the formulation of essential competencies (i.e., graduate learning outcomes and subject learning outcomes) that students must acquire, the design of appropriate media, the preparation of instructional materials, and the selection of appropriate evaluation methods throughout the course of instruction. Regarding the development of learning designs, all activities are documented in the semester learning plans (RPS) that have been established. The components encompassed under the RPS comprise of graduate learning outcomes (CPL) and course learning outcomes (CP-MK). Additionally, the RPS includes Course Descriptions, which provide a comprehensive overview of the subject matter being taught, including specific subjects to be covered, references (libraries), and learning resources.

Result of Evaluation Activities

At this stage, a blended learning program was developed which was based on the results of validation by expert validators and phase I product revisions. The development steps are described as follows:

a. The main product is in the form of electronic media (web blended learning). The product in question is learning using the Unismuh Spada website which can be described in a simple way which is still in the development stage as follows.

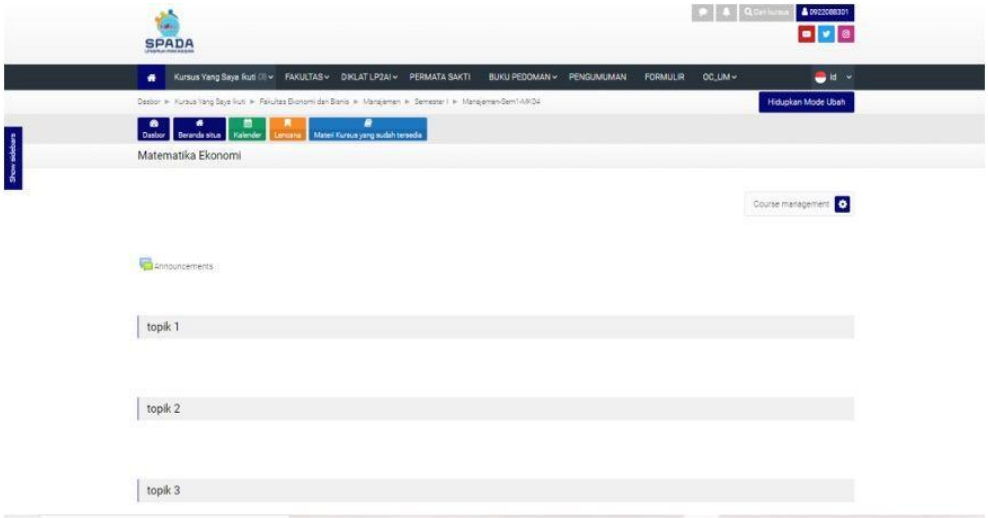

Figure 2. Display of Blended Learning-Based Mathematics Economics Learning Program

The economics mathematics course will encompass a diverse array of materials that have been classified into distinct subjects for examination over the course of a single semester in the present academic year. The material that has been prepared consists of a

total of 15 chapters that cover a wide range of issues within the fields of economics and business. The chapters in question encompass a range of topics pertaining to the mathematical aspects of economics and business. These include the examination of economic models, functions, linear functions, systems of linear equations, as well as the application of linear functions. Additionally, the chapters explore nonlinear functions, their applications, exponential and logarithmic functions, and the application of these functions. Furthermore, the chapters delve into the study of sequences and series, their applications, differential calculus for functions with one independent variable, optimization for functions with one independent variable, and the application of differential calculus for functions with one independent variable. The educational resources encompass modules and instructional DVDs, which function as teaching materials for each subject matter. The following passage serves as an illustration of an educational video presentation found in Chapter II. Subsequently, the film will be incorporated into the online learning platform, specifically within the framework of blended learning.

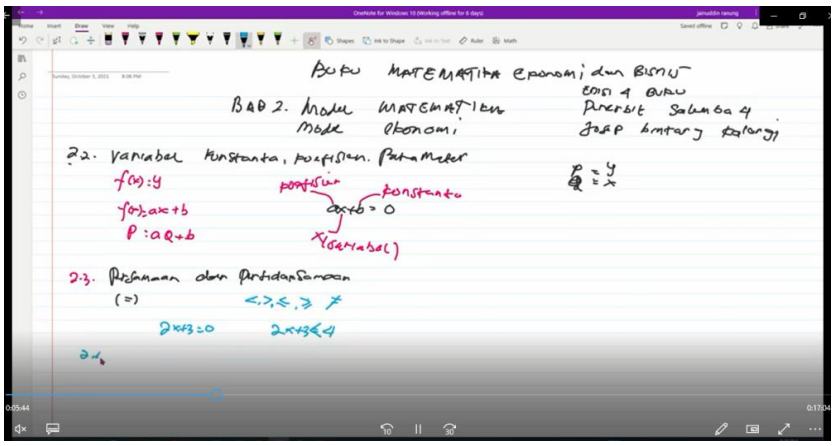

Figure 3. Display of Learning Video for Blended Learning-Based Mathematics Economics Learning Program

b. The components found in electronic media include: (a) a cover that displays the course title, lecturer's name, course identity, and relevant images; and (b) the course content, which encompasses course descriptions, learning outcomes (CP-MK), study materials, descriptions of course materials for each sub-CP-MK, online lectures with indicators and evaluation/assessment methods, as well as assignments and quizzes for each lecture material. The subsequent passage serves as an illustration of the content provided in Chapter II.

BAB II

MODEL EKONOMI

A. VARIABEL, KONSTANTA, KOEFISIEN DAN PARAMETER

Model matematika sering dinyatakan dengan sekelompok tanda atau simbol masing-masing terdiri atas beberapa kombinasi variabel, konstanta, koefisien, dan parameter. Simbol-simbol ini mewakili satu bilangan nyata atau sekelompok bilangan nyata. Dengan demikian, dibutuhkan kemampuan untuk memahami model matematika yang sering dinyatakan dalam bentuk sekelompok tanda atau simbol. Berikut disajikan deskripsi variabel, konstanta, koefisien, dan parameter.

1. Variabel

Variabel adalah yang sesuatu nilainya dapat berubah- ubah dalam suatu masalah tertentu. Variable dalam matematika murni sering dilambangkan dengan huruf

Figure 4. Display of Subject Matter for Blended Learning-Based Mathematics Economics Learning Program

Furthermore, the administration administered a questionnaire to conduct a comprehensive evaluation aimed at assessing students' impressions of the learning program. The assessment of the practicality of the created prototype involved the utilization of questionnaire data gathered from both one-to-one evaluations and small group evaluations. The results obtained through the administration of questionnaires were analyzed using a Likert scale to evaluate the viewpoints and perceptions of students regarding the instructional materials that were created. The instructional materials are delineated in the table presented by Haking et. al. (2020).

Table 1. Questionnaire score category

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

The data obtained from the completion of the questionnaire is organized and presented in a tabular format. Subsequently, the percentage is calculated using the prescribed formula.

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

$$S_i = S_m \times n$$

Description:
N = total answer score for each item
S_i = total of item's ideal score
S_m = total of maximum score
n = many sample

Table 2. 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

Based on the results of filling out a questionnaire from 40 students who became the subject of research, it is described as follows.

Table 3. Respondents' Assessment Result and Response

Observed Aspects	Evaluation (%)
Attractive display design	80
Use of fonts: type and size	86.67
Information clarity	80
Lecture material is stated clearly	86.67
Ease of accessing information	86.67
The learning steps are described systematically and clearly	80
Clarity of pictures, graphs, tables, diagrams, and the like	80
Motivation to study the material	80
Not using the local language (cultural bias)	80
Use language that is in accordance with Indonesian rules	86.67
Use communicative language	80
Time allocation in the learning process is well regulated	93.33
Learning tools support to achieve learning objectives	66.67
Learning resources are relevant to the material to be presented	86.67
The use of punctuation in writing is clear and correct	93.33
The use of mathematical terms in writing is correct	93.33
Average	83.75
Category	Practical

Based on the data provided in the table, it can be inferred that the assessment results suggest that the learning programs and materials developed through the implementation of a blended learning approach effectively tackle real-world challenges. This is supported by the average score of 83.75 obtained from the two technical evaluations. Hence, the curriculum and associated materials for blended learning exemplify pragmatism. Therefore, these materials are appropriate for integration into a curriculum focused on the intersection of economics and mathematics.

DISCUSSION

The present study elucidates the outcomes of prior research, which provide an account

of the formulation of a blended learning curriculum for a mathematical economics course. This curriculum is constructed upon a learning model that is rooted in an integrated learning design framework. The inclusion of an exploratory factor in the learning process facilitates students' access to lecture material that is aligned with learning planning competencies, hence enhancing the ease of learning. In addition to this, it is imperative that graduates possess competencies that align with the demands of the job market. The educational material is furnished with student worksheets that are designed to enhance competency-based learning management patterns, hence facilitating student progress in developing their competencies.

A study was conducted on the blended learning program, focusing on the integrative learning design framework, with consideration given to the competency components and generated learning materials. In addition to this, many learning approach patterns are elucidated based on students' level of cognitive development and the incorporation of technology in the learning process. The emphasis is placed on high-level talents that align with students' cognitive capacities, with the aim of enhancing their grasp of the subject matter in mathematical economics. In addition, a set of learning strategies were developed, comprising of (1) pre-learning activities, information presentation, student engagement, assessment administration, and post-learning activities, as well as the design of learning time and resource allocation, and the creation of evaluation tools, (2) execution of the learning process, and (3) assessment of the learning outcomes.

During the evaluation phase, a comprehensive blended learning program is developed and validated through a series of expert assessments, trials, and validation phases. This ensures that the program is fully developed and suitable for implementation in the learning process. The trial learning program encompasses a group of students and professionals specializing in the domains of learning, economics, technology, and information-based learning media. The study yielded results that provided an overview for enhancing the ongoing development of a learning program with the objective of improving both the quality of education and students' character. Based on the findings of the evaluation, it is evident that the blended learning program used in mathematics economics courses falls within the practical realm, serving as a viable alternative instructional approach for enhancing students' comprehension of the subject matter.

Therefore, this educational application functions as a comprehensive instructional tool that effectively leads and facilitates the activities of both educators and learners throughout the educational journey. The use of experiential learning in students is anticipated to facilitate the development of cognitive, metacognitive, logical, and collaborative thinking skills, as well as foster constructive understanding within the realm of education (Kingkaew et al., 2023). This finding aligns with the findings of Qazi and Mtenzi (2023), who conducted research on the implementation of blended learning models in educational programs. Their study emphasized the importance of incorporating evidence-based theories and practical considerations into the design of online learning experiences for both instructors and students. The blended learning program using the Integrated Learning and Discovery Framework (ILDF) offers students the chance to connect their personal experiences to tangible concepts, enabling them to demonstrate everyday phenomena they encounter (Capone, 2022). This aligns with the findings of Mettis and Väljataga (2021), who demonstrated that students have the capacity to acquire additional information by active engagement with their own activities, thereby establishing a direct connection between students and the subject matter under study.

Furthermore, the curriculum for economics mathematics education is intricately connected to the everyday experiences of

students, so affording them increased possibilities to apply their knowledge and problem-solving skills to real-life scenarios. The aforementioned assertion is substantiated by the findings of Pérez-Álvarez et al.'s (2018) study, which demonstrates that the utilization of ILDF in Learning and Development Planning consistently establishes connections between students' real-life experiences and scientifically explainable phenomena. In addition, the use of the ILDF approach in this educational program has the potential to encourage students to actively select learning materials and engage in challenging tasks, hence fostering the development of critical thinking abilities and problem-solving skills (Al-Furaih, 2017; Bizami et al., 2023).

Hence, the utilization of a learning program incorporating an experiment-based blended learning model presents a viable alternative educational approach for the purpose of transforming and enhancing students' conceptual comprehension, as well as facilitating shifts in students' conceptions (Zimba et al., 2021). Furthermore, this educational program can serve as a learning tool that enhances the learning process in an engaging and scholarly manner, while fostering comprehension of a sound concept through self-directed learning (Tupas & Linas-Laguda, 2020). Furthermore, the implementation of this integrated learning program offers students the chance to enhance their deductive reasoning abilities in order to effectively address economic issues by applying relevant mathematical principles (Jawad et al., 2021). This finding aligns with the scholarly work of Sheridan and Gigliotti (2023), who conducted research demonstrating that the utilization of experiential learning models within blended learning environments has the potential to enhance students' deductive reasoning skills and foster greater autonomy in their learning process. According to Tong et al. (2022), the incorporation of a blended learning program has an impact on students' cognitive abilities in comprehending the instructional content delivered during the learning experience.

This study demonstrates that the integration of a blended learning program inside the electronic learning environment has a beneficial influence on students' attitudes towards mathematics. This, in turn, has the potential to enhance the cognitive, attitudinal, and skill-based dimensions of the mathematics learning process (Salhab & Daher, 2023). Hence, the utilization of the blended learning model in the economics mathematics course, using an experiential-based ILDF approach, has the potential to enhance students' cognitive learning outcomes and foster the development of their processing skills.

CONCLUSION

This study highlights the importance of including a dependable and relevant educational curriculum and instructional materials to provide a student-centered learning environment for those participating in blended learning approaches. Therefore, the proficiency of an educator is crucial in formulating a pedagogical framework that integrates a blended learning approach, thereby enabling students to effectively access, recall, and grasp educational materials relevant to their academic needs. The utilization of the integrated learning design framework (ILDF) model is a widely adopted methodology within the realm of development studies. This paradigm consists of three discrete stages: exploration, preparation, and evaluation. Therefore, it is crucial to promote collaboration among educators who function as creators of educational curricula and instructional resources, in conjunction with a group of specialists in mathematics, economics, assessment, and educational media and technology. The relationship holds significant importance, especially within the framework of creating instructional resources for the mathematical economics curriculum. The active participation of the expert team will greatly enhance the development process, wherein students will

assume the role of users to provide an evaluation of the viability of the blended learning materials and programs that have been generated. The application of blended learning, employing the Integrative Learning Design Framework (ILDF) methodology, in a practical mathematical economics course, provides students with the chance to develop self-reliance in understanding course material and addressing economic issues using a mathematical problem-solving approach that integrates pertinent mathematical concepts. Hence, the implementation of this blended learning methodology enhances students' capacity to exhibit ingenuity in resolving problems, leveraging their distinct educational backgrounds, thereby guaranteeing the preservation of educational excellence.

Declaration by Authors

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