Development Of Economic Mathematics Learning Media Based on Android

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Abstract. The design thinking development model, which covers the processes of empathizing, defining challenges, ideation, prototyping, and testing, is the subject of this research, which is a sort of research and development. Students and lecturers are the research's subjects. An android-based application for economic mathematics classes is the focus of this study. The goal of this work is to create a learning tool for economic mathematics based on an Android application. An android-based application product for economic mathematics content is the study's output, and it is available for download from the Google Play store. Users claim that the validation test findings are practical for the application's presentation and menus and helpful for autonomous as well as online and offline learning. This application is used to connect with students and professors and to support learning.

Keywords: Android, Design Thinking, Mobile Learning, Economic Mathematics

1. Introduction

A person engages in learning activity when they make an effort to change their overall behavior as a result of their interactions with their surroundings (Slameto, 2010). Meanwhile, learning is a set of actions that contain a series of events designed in such a way as to influence and promote the internal student learning process, according to Gagne and Briggs (1987) in Arsyad (2011). According to professional opinion, learning activities are activities that involve a sequence of events with the goal of improving behavior.

The accomplishment of learning objectives is a sign of a high-quality education. A change in behavior for the better is a sign that learning objectives have been met. Changes in knowledge (cognitive), abilities (psychomotor), and values and attitudes (affective) are among them (Hamalik, 2011). The implementation of these changes is impacted by a number of variables, including teachers, students, the environment, teaching strategies, and learning resources.

Anything that can be used to transmit messages from sender to receiver in order to stimulate students' thoughts, feelings, concerns, and interests and concerns in such a way that the learning

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process occurs is referred to as media (Sadiman, 2006). While learning media refers to anything that is used to channel messages and stimulate the learner's thoughts, feelings, attention, and willingness in order to encourage a deliberate, purposeful, and controlled learning process (Miarso, 2004). The purpose of using learning media is to make it easier for teachers to communicate information to students. Because they can be used independently at home, students can also use some learning media to prepare materials.

The development of technology is increasing day by day. One of them is on a cell phone or cell phone. Yusra (2016) said that there was an increase in smartphones in Indonesia based on research results reported by the President Director of Ericson Indonesia, Thomas Jul during a media meeting. This increase was seen in the mobility report for the Southeast Asia region and Indonesia for the first quarter of 2016. In his presentation, the Asia Pacific (APAC) region showed quite high growth in terms of mobile subscriptions and subscribers. Indonesia contributed to the growth in the number of new users by 5 million users and put Indonesia in the third position in the APAC region with India and Myanmar in the first and second positions. The report states that there is a 38% increase in users compared to 2015 and is expected to continue to increase up to 98% in 2021. The report also provides information about the habits of people who access the internet every day. It is stated that Youtube is the most accessed application by the people of Indonesia, followed by Whatsapp, BlackBerry Messenger, Google, and Line. This survey was conducted throughout May 2016 on the Android and iOS (iPhone Operating System) platforms.

According to Amalia (2016) based on a report from the Pew Research Center, in 2016 smartphones in Indonesia rose to 21%, and Internet users made up 30% of the total population in Indonesia. Cell phones or cellphones that initially had a function limited to communicating remotely via voice and short messages have now developed into smartphones or smartphones that have many functions. A smartphone, also known as a cell phone, is a mobile phone device that can be used for basic communication (telephone and sending short messages). It includes a PDA (Personal Digital Assistant) function that works like a computer but is smaller in size.

According to the number of smartphones in Indonesia, the majority of people still use them to access social media, instant messaging, and social video. The majority of people use smartphones to track their daily activities. This also applies to Unimed accounting students. According to the findings of the researchers' direct observations, the majority of them use smartphones to play games, listen to music, and access social media. While educational applications on smartphones are still limited to using browsers to access information from the internet and electronic dictionaries, as a result, one of the opportunities to use smartphones in education is to create learning media that are innovative, creative, interactive, and can be used anywhere and at any time. One of them is the development of Android.

The Android operating system currently controls nearly 70% of smartphones. According to Khalis (2017), one of the reasons for the large number of Android devices is the Android operating system, which is opensource, which means it is free to use for application developers. This simplifies the creation of various types of applications by developers or application developers. Furthermore, Khalis (2017) stated that Android has guaranteed privacy security. This is due to the fact that Android is Google's operating system, which is well-known for protecting user privacy. Android users are also well served because they can obtain applications

from the Play Store. It can also be shared between phones using a data transfer device (Bluetooth).

According to the author's observations, economic mathematics is a subject that students find difficult. When compared to other subjects, mathematics is thought to require more understanding. Students also reported that, due to network constraints and other factors, explanations from lecturers were sometimes difficult to understand during online lectures. If there are learning media other than learning modules and videos, it will help students understand learning because written explanations become audio-visual and interactive, and become one of the materials, explanations, and assignments in one application. As a result, media that creates a pleasant environment for students to focus on the material being studied is required. As a result, the author attempts to offer a solution. As a result, the author attempts to provide a solution by conducting research titled "Development of Android-Based Economic Mathematics Learning Media."

Based on the foregoing, several issues can be identified: learning outcomes and levels of understanding remain low, media in the online learning process remains limited, the use of media in the form of videos remains limited and unstructured, and online learning is constrained by networks and learning media is required. modules, videos, and exercises are all interconnected. The formulation of the problem is as follows, based on the identification of the problem: how is the development of android-based economic mathematics learning media? Is it appropriate to use the development of android-based economic mathematics learning media? The goal of this study is to create android-based economic mathematics learning media and to examine the process of creating valid android-based economic mathematics learning media.

2. Literature Review

2.1. Research Development

Research and development is another term for development research. According to Sugiyono (2006: 407), research methods development is a research method used to create products and test their effectiveness. According to Gay (1990), the research and development model is an attempt to develop educational products that are effective in the form of learning materials, media, strategies, or materials used by others in learning for use in schools, rather than to test theory. Endang Mulyatiningsih (2011) defined research and development (research and development) as a process or steps to develop a new product or improve existing products in the form of objects or devices hardware, such as books, modules, learning aids in class or laboratories, or models of education, learning, training, and guidance.

Development, also known as research and development in English, is a method of research used to create a specific product and test its effectiveness. Based on the four experts' opinions, it is possible to conclude that research and development in the field of education and learning is a research model that aims to develop and validate educational products and learning in order to improve and develop quality effective education and learning. The outcome of the research model It is hoped that this will be used to improve and develop educational and learning quality.

2.2. Design Thinking Procedure

Design thinking is a method with a comprehensive thought process that focuses on creating market opportunities and solutions, beginning with a process of empathy for a specific human-centered need and progressing to a sustainable innovation based on the needs of its users (Brown, 2009). During the process, design thinking employs a human-centered approach aimed at understanding the problems or needs of the users.

Design thinking, according to the interaction design foundation, is an iterative process that seeks to understand users, answer assumptions, and redefine problems in order to identify alternative strategies and solutions that may not be immediately obvious with an initial level of understanding. Simultaneously, design thinking provides a solution-based approach to problem solving (Soegaard, 2018).

Based on the foregoing, it is possible to conclude that design thinking is a design method with an iterative process that focuses on creating opportunities and solutions in order to produce strategies for sustainable innovation based on the needs of its users. One of the new methods for carrying out the design process is design thinking. Using a designer's mindset can alter how businesses develop products, services, processes, and strategies. This approach has the potential to combine what is desirable from a human standpoint with what is technologically and economically feasible.

Design thinking has three process spaces for effectively forming innovation. The three areas are for inspiration, ideation, and execution (Brown, 2009). The three process spaces in this design method are iterative in nature and have an exploratory process in reviewing ongoing discoveries. The following are three processes in design thinking: a. Inspiration is the process of understanding a problem or opportunity that motivates the surrounding conditions to find a solution. Usually, this is done by observing and analyzing the constraints of all things that have been or are currently running. From this, it will be possible to become an opportunity that can be a source of innovation. b. Ideation is the process of generating, developing, and testing ideas that lead to solutions. This is done after the data is obtained, by conducting observations and research. The resulting design will be tested so that it can be repaired or prepared until it is launched as a product or service. The process of testing ideas can be done continuously by repeating the process to get the best results. c. Implementation is the process of planning and implementing the resulting solutions into the actual market. This process can be done using a prototype. In this process, the product can generally be released in the process. So that the feedback process can be carried out directly by the user.

With the iteration process done correctly, it will certainly get better results than the previous process. However, it is important to note that there are limitations, both time and cost, which are separate considerations for how long the iteration process should take.

2.3. Learning Media

Learning media, according to R. Ibrahim and Nana Syaodih (1996), are "anything that can be used to convey messages or lesson content, as well as stimulate students' thoughts, feelings, attention, and abilities in order to encourage the teaching and learning process." Meanwhile, teaching media, according to Nana Sudjana and Ahmad Rivai (2010:1), is a methodological

component of one of the learning environments used by the teacher. Every teacher must have sufficient knowledge and understanding of educational or teaching media in order to use educational media effectively. Teachers must always be creative and understand the needs of their students as technology advances. Learning and media knowledge and understanding will be presented in the following sections. Knowledge and understanding of learning media, according to Oemar Hamalik in Azhar Arsyad (2004:2), include a. Media as a communication tool to make the teaching and learning process more effective. b. The role of the media in achieving educational objectives c. The complexities of the learning process d. The connection between instructional methods and educational media. e. The value or benefits of educational media in teaching f. educational media selection and use g. A wide range of educational media tools and techniques h. Media education in all subject areas. i. Efforts to innovate in educational media. As a result, it is possible to conclude that the media is an essential component of the teaching and learning process in order to achieve educational goals in general and learning objectives in schools in particular. Learning media has its own place in the learning process.

2.4. ICT-Based Learning Media

According to Nieven (1999) in Khabibah (2006), quality information and communication technology (ICT)-based learning media in mathematics learning is defined as meeting the following indicators:

1. Valid according to experts. Experts are validators who are competent to assess learning media and provide input or suggestions to improve learning media that have been designed. The assessment of the experts includes three aspects, namely: a. Format aspects: 1) Clarity of working instructions; 2) Format conformity; 3) The suitability of the contents on the worksheet with the desired definition; 4) The suitability of the answers on the worksheet with the desired definition. b. Aspects of content: 1) Preparation of material on the android; 2) The suitability of the material with the android; 3) The harmony of colors, text, and images on the android; 4) Color suitability, image display, and writing on the material; 5) The suitability of the display of images and writing in the practice questions; 6) The role of android to make it easier for students to work. c. Aspects of language: 1) Standardization of the language used; 2) Ease of students in understanding the language used.

2. Android-based learning media is said to be practical if it meets the following criteria: a. According to the validator, the learning media can be used with little or no revision. b. The analysis of recorded student responses reveals that the learning media can be used with little or no revision.

3. Android-based learning media is said to be effective if it meets the following criteria: a. Android can be said to be effective if the average score of the student learning outcomes test obtained by trial subjects was greater than or equal to 80% of all due diligence subjects. b. There is a positive response from students, as evidenced by the questionnaire. c. Analysis of student activity observation sheets revealed that the learning media could be used with little or no revision.

According to Wahono (2006), several aspects and criteria in the assessment of the development of learning media based on Information and Communication Technology (ICT) are:

1. Aspects of Software Engineering a. Effective and efficient in the development and use of learning media, specifically the accuracy in the use of sources or resources (RAM, processor, and memory) so that the programs created run quickly. Android has speed, temporary storage capacity, and fixed storage capacity limitations. b. Dependable (Reliable). When the program is used correctly, it does not hang, crash, or stop. c. Long-lasting (Maintenance). Programs should be written with code that is neither too complicated nor too extensive so that they can be easily modified, repaired, or changed. d. Usability (Usability) displays a display in the form of buttons or icons that can be useful for new users who are unfamiliar with the program. e. The Accuracy of Application Type Selection for Development. f. Compatibility (Compatibility), which means that the media can be run in a variety of hardware and software that differ and are not limited to specific specifications. g. Integrated learning media program packaging and complete documentation of learning media programs h. Recyclable (Reuse). A portion or all of the learning media programs can be reused to create additional learning media.

2. Learning Design Aspects Aspects of learning design include a) learning objectives that are clear. Goals are written in language that is simple, realistic, and measurable. b) interactivity; c) the scope and depth of the structured learning objectives; d) the accuracy of the use of learning strategies; e) providing motivation to learn; f) contextual and actuality; g) the material presented is arranged systematically, sequentially, and the logic flow is clear; h) the accuracy and determination of the evaluation tool; i) providing feedback or response

3. Visual Communication Aspects Six categories of visual communication aspects exist: a) Communicative: visual and audio elements that correspond to the teaching material and are easily understood by students. b. Innovative: the visualization is presented in a novel way that draws the attention of the students. c. Simple: Visualization is not complicated, but it still gives students an interesting impression, allowing them to focus on the presentation of the material. d. Audio elements (narrative, sound effects, and background music) based on the characters and topics. e. Theme-related visual elements (layout, design, typography, color) that draw attention f. The interface layout (navigation icons) is organized in a recognizable and consistent manner.

Based on these experts' opinions about the aspects and criteria of good information and technology-based learning media, the researchers established several aspects and criteria for android-based mathematics learning media that will be developed and evaluated by material experts, media experts, and learning practitioners. The aspects and criteria of android-based mathematics learning media borrow and modify those presented and described by Nieven (1999) in Khabibah (2006). Aspects and criteria are tailored to the needs and characteristics of the created media.

2.5. Operating System Android

According to Rasjid (2010), Android is mobile device software that includes an operating system, middleware, and key applications. Java application development on the Android platform A collection of core Android applications such as an e-mail client, SMS, calendar, folder, browser, contacts, and so on. Android is made up of several different components with interconnected functions. According to Anthony (2013), android is an important component of an android because an android can run well with these components. Android Manifest.xml is in charge of these components. An android application consists of four major components:

1. Extracurricular activities A component that manages user interaction with the smartphone screen and controls the user interface. An activity represents a screen with a user interface, or an activity that does something on the screen. A subclass of the activity class can be used to implement an activity.
2. Services. A component that handles the background associated with the application. For example, we can browse on a smartphone while listening to music. The display on the smartphone is a browser, while the music is run by the service without disturbing the browser display.
3. Content Providers. A component that handles data and database management issues. The contact provider supplies data from one application to another when the data is requested.
4. Broadcast Recipients A component responsible for communicating between the operating system and the application. Broadcast receivers react to messages sent by other applications or the system. The Android operating system has several versions, each with its own unique name and a variety of advantages ranging from appearance to security optimization. The following androids were released in the following years:

Table 1. Android

Nama	Versi	Rilis
Android 1.0	1.0	23 September 2017
Android 1.1	1.1	9 Februari 2008
Cupcake	1.5	30 April 2009
Donut	1.6	15 September 2009
Eclair	2.0-2.1	26 Oktober 2009 (2.0) 12 Januari 2010 (2.1)
Froyo	2.2	20 Mei 2010
Gingerbread	2.3	6 Desember 2010
Honeycomb	3.0-3.2	22 Februari 2011
ICS (Ice Cream Sandwich)	4.0	19 Oktober 2011
Jelly Bean	4.1-4.3	9 Juli 2012 (4.1) 13 November 2012 (4.2) 24 Juli 2013 (4.3)
Kit Kat	4.4	3 September 2013
Lolipop	5.0	3 November 2014
Marshmallow	6.0	28 Mei 2015
Nougat	7.0	22 Agustus 2016
Oreo	8.0 – 8.1	21 Agustus 2017
Pie	9.0	6 Agustus 2018
Android Q	10.0	3 September 2019
Android 11	11.0	8 September 2020
Snow Cone	12.0	4 Oktober 2021

3. Research Methods

3.1. Research Implementation

The study was carried out at Unimed's Faculty of Economics, Accounting Education Study Program. This study was conducted from May 2022 to December 2022. Unimed students and economics and mathematics lecturers were the subjects of this study. The goal of this study is to create economic mathematics learning media based on Android. Data can be collected in a variety of settings, from a variety of sources, and in a variety of ways. However, in this study, researchers used data collected in the traditional manner of observation, interviews, and questionnaires (Sugiyono 2016:193).

3.2. Research Methods

This research uses design thinking research procedures. Design thinking is a collaborative method that collects many ideas from disciplines to obtain a solution. Design thinking does not only focus on what is seen and felt but also focuses on the user experience. Design thinking is used to find the most effective and efficient solution to solve a complex problem. The thinking applied is comprehensive thinking to get a solution. Design thinking is divided into 5 stages (Stanford d. School) as follows:

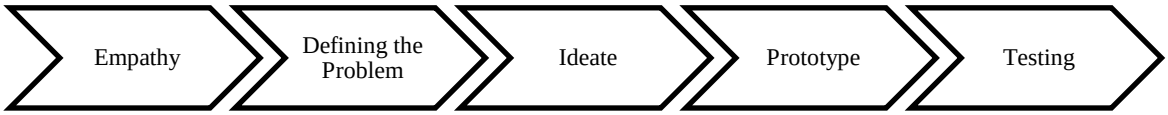

Figure 1. Design Thinking Model Chart

Based on the sequence of steps and the design thinking model development scheme, a product development design can be drawn up, in this study with the following explanation:

1. Empathy. Empathy is a core process because problems that arise must be resolved in a human-centered way, this method seeks to understand the problems experienced by users so that we can feel and find solutions to these problems in this method there are several things that must be done, namely interview, observation, and combining observation and interview.

2. Defining the Problem. Define is the process of analyzing and comprehending the results of the Emphasize process. the process of analyzing and comprehending various insights gained through empathy in order to determine the problem statement as the primary point of view or concern for the research.

3. Ideate. Ideate is a transition process from problem formulation to problem solving; during this ideate process, it will focus on generating ideas or ideas as a basis for making prototype designs to be made.

4. Prototype. A prototype is the initial design of a product that will be manufactured in order to detect errors early and obtain new possibilities. The initial design will be tested for users in its application to obtain appropriate responses and feedback to improve the design.

5. Testing. Testing is performed to collect various user feedback from various final designs that were developed during the previous prototype process. This is the final stage, but it is a life cycle, so it can loop and return to the previous design stage if there are errors.

4. Results and Discussion

4.1. Empathy

According to observations, there is no android-based application that is used for the teaching and learning process, so during the distribution process the material still uses a flash, which can slow down the teaching and learning process because it must be copied one by one, giving and collecting assignments that are still done manually or in print can cost a lot of money, and e-modules are not yet integrated, so rescheduling.

According to the research review, there is no android-based application that is used by students and lecturers, so an android-based application must be developed to aid in the teaching and learning process. Researchers conducted interviews with lecturers who teach economics mathematics courses and students to identify the obstacles and problems that are frequently encountered when using android-based applications so that they can be used as references when developing useful applications.

Following field research and observation of the learning process where currently mixed learning is carried out, namely online and offline, learning aids that can be used by lecturers and students online and offline are required. Android-based applications are also required for student learning autonomy. Lecturers/teachers and students are the application's stakeholders. The conclusion is that an android-based application that can improve the learning process and be implemented and accessed anywhere and at any time with a simple display is required.

4.2. Define

Based on the experience of students and lecturers while studying and there is no use of an android-based application so that it can be seen how their journey during the online and offline teaching and learning process. It takes learning to use android-based applications and we can overcome the problems faced or obstacles during the teaching and learning process so that from there we can learn to make useful applications. Based on user experience, several needs and desired designs were found.

4.3. Ideate

At this stage, the author creates a rough design of the Android-based application storyboard based on the needs and problems identified above. The author creates a design that will later be updated based on the user's response to the application. At this stage, the authors discuss the decisions that have been made and share their thoughts for the next design stage on the display design that the user has chosen.

4.4. Prototype

Here's a look at the economics math android application

- Login Display

- Home Menu Display

Figure 2. Login and Home

- Preface Display

Figure 3. Display Preface

- View Table of Contents Theory – Chapter

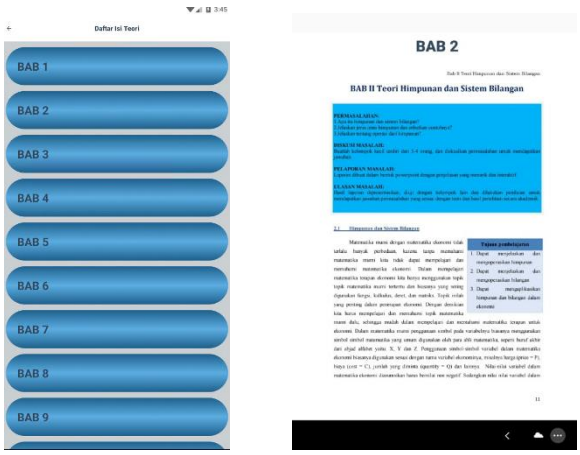

Figure 4. Display of Table of Contents Theory and Chapters

- Video List View - Video

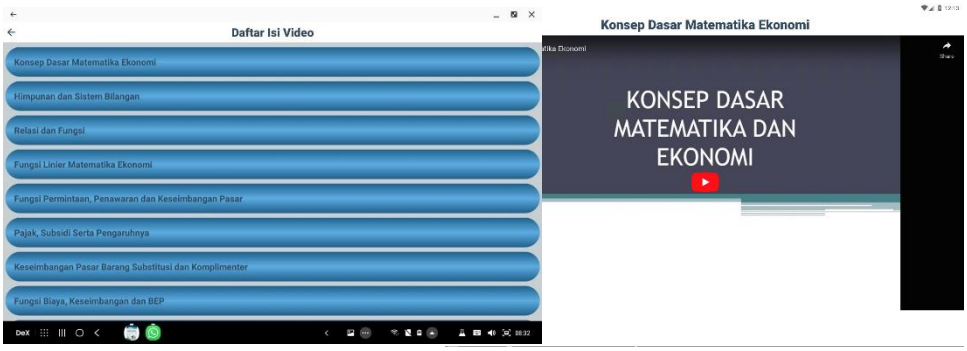

Figure 5. Video List View

- Presentation List View – Presentation

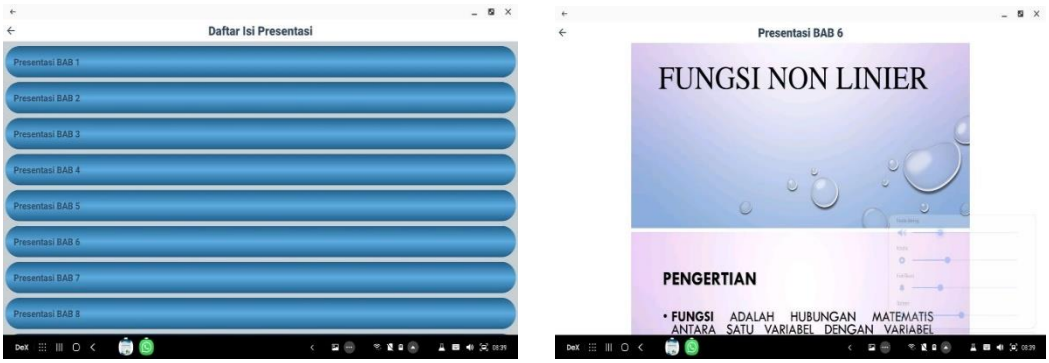

Figure 6. Presentation List View

- Exercise List View - Exercises

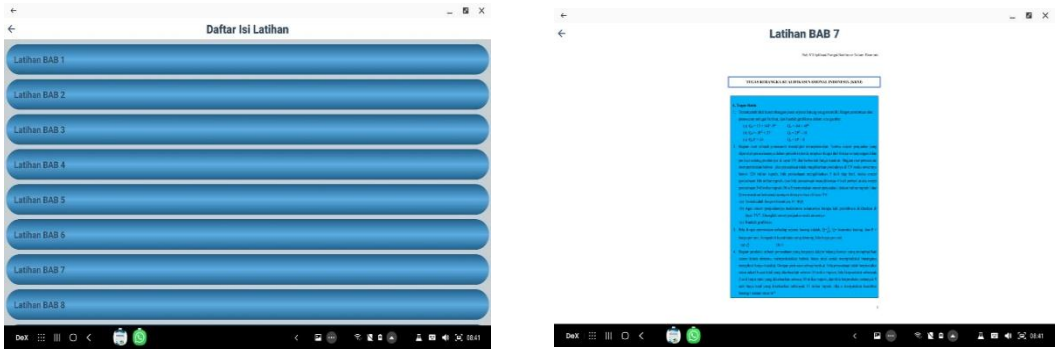

Figure 7. Exercise List View

4.5. Test

At this stage, the researcher performs a test or displays the appearance of the created design, as well as gives the user the opportunity to try out the simulation application. The test results show only a few minor revisions that have been improved. Users of the application, in this case students, are greatly aided in the teaching and learning process both online and offline, and can be used for independent and group learning. This application is also rated highly by lecturers as useful for the teaching and learning process.

5. Conclusions and Recommendations

The following are the conclusions that can be drawn from this research. The first is that this development research produces teaching materials products in the form of android-based

applications for economic mathematics courses that can be installed via the app application. This study is based on the Design Thinking development model, which includes the stages of empathize, define, ideate, prototype, and test. The second result of this research is an Android application that is said to be feasible by users for the display and menu contained in the application, as well as useful for online and offline learning as well as independent learning. This application is used to reach out to students and lecturers and facilitate the learning process.

The first suggestion that can be made from this research is that this android-based application be used by lecturers and students of economics mathematics courses in all study programs in the economics faculty. The second issue is that the research has not been conducted to test the practicability and effectiveness of students in using it, so it is hoped that future research will test the practicability and effectiveness of using android-based applications. Finally, more research is expected to be conducted in order to develop IOS-based products and create more interactive and interesting applications.

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