E-MODUL BERBASIS ANDROID *"KITKAT VERSI 4.4"* UNTUK MEMFASILITASI *ASYNCHRONOUS LEARNING* MAHASISWA PENDIDIKAN MATEMATIKA DI TERNATE

Android-Based E-Modul "Kitkat Version 4.4'' To Facilitate Asynchronous Learning For Mathematics Education Students In Ternate

Teguh Wibowo[1], Ageng Triyono[2], Rusmin R. M. Saleh[3], Rusdy Habsy[4], Riawan Yudi Purwoko[5]

[1,5]Program Studi Pendidikan Matematika, Univeritas Muhammadiyah Purworejo
Jl. K.H. Ahmad Dahlan No 3 & 6 Purworejo
[2]Program Studi Pendidikan Matematika, STKIP Kusumanegara Jakarta Timur
Jl. Raya Bogor, Kec. Pasar Rebo, Jakarta Timur, DKI Jakarta 137070
[3,4]Program Studi Pendidikan Matematika, STKIP Kie Raha Ternate
Jl. STKIP Kie Raha, Sasa, Kec. Ternate Selatan, Kota Ternate, Maluku Utara

ABSTRACT:

Learning in asynchronous learning in introductory basic mathematics courses in Ternate is hampered by unstable internet conditions. These conditions require the existence of electronic teaching materials that can be accessed when conditions without the internet. So this study aims to develop electronic teaching materials in the form of e-modules that meet valid and practical criteria as an alternative solution to the constraints experienced during the asynchronous learning process in introductory basic mathematics courses. This goal will be achieved through the Research and Development (R&D) method which is carried out following the stages of the ADDIE model. The research subjects involved consisted of 1 instrument expert, 2 material experts, 2 learning technology experts, 1 IT expert, and 11 Mathematics Education students at STKIP Kie Raha-Ternate. Research data were collected using instruments in the form of material validation sheets, media validation sheets, and practicality response questionnaires. The data obtained was analyzed for its validity from the material aspect, media aspect, and practicality aspect. Based on the

results of data analysis, it can be shown that the developed e-module has met the valid criteria from the media aspect and the material aspect. In addition, e-modules are also practical when implemented using the asynchronous learning method. So it can be concluded that the research conducted has achieved the stated objectives.

ABSTRAK

Pembelajaran pada mata kuliah pengantar dasar matematika secara asynchronous learning di Ternate terhambat oleh kondisi internet yang tidak stabil. Kondisi tersebut menuntut adanya bahan ajar elektronik yang dapat diakses ketika kondisi tanpa internet. Maka penelitian ini bertujuan untuk mengembangkan bahan ajar elektronik berupa e-modul yang memenuhi kriteria valid dan praktis sebagai alternatif solusi terhadap kendala yang dialami selama proses asynchronous learning pada mata kuliah pengantar dasar matematika. Tujuan tersebut akan dicapai melalui metode Research and Development (R&D) yang dikerjakan mengikuti tahapan model ADDIE. Subjek penelitian yang terlibat terdiri dari 1 orang ahli instrumen, 2 orang ahli materi, 2 orang ahli teknologi pembelajaran, 1 orang ahli IT, dan 11 mahasiswa Pendidikan Matematika STKIP Kie Raha-Ternate. Data penelitian dikumpulkan menggunakan instrumen berupa lembar validasi materi, lembar validasi media, dan angket respon kepraktisan. Data yang diperoleh dianalisis validitasnya dari aspek materi, aspek media, dan aspek kepraktisan. Berdasarkan hasil analisis data dapat ditunjukkan bahwa e-modul yang dikembangkan telah memenuhi kriteria valid dari aspek media dan aspek materi. Selain itu e-modul juga praktis jika diterapkan menggunakan metode asyncrhonous learning. Sehingga dapat disimpulkan bahwa penelitian yang dilakukan telah mencapai tujuan yang ditetapkan.

INTRODUCTION

North Maluku Province has 3,860 educational institutions ranging from Play Group (KB) to High School (SMA) levels (https://dapo.kemdikbud.go.id/sp/1/270000). This number continues to increase following the process of

building educational facilities which is carried out on an ongoing basis by the local government. This has an impact on increasing the need for teachers in North Maluku Province. If it is based on the type of subject and the allocation of the number of hours of study, then mathematics teachers are needed the most compared to teachers of other subjects (Dewi, 2019; Setiawan, 2020; Yusdikasari, 2015; Ika, 2014). The needs of the mathematics teacher became a consideration for researchers to examine more deeply the readiness and competencies that must be possessed by students of the mathematics education study program in the educational environment of North Maluku.

In the North Maluku region there are 3 tertiary institutions that have opened mathematics education study programs, namely; Khairun University (UNKHAIR), IAIN Ternate, and STKIP Kie Raha, of which the three universities are located in Ternate City. The city of Ternate is then seen as a barometer of the progress of the development of the education sector in North Maluku Province because of the existence of these several tertiary institutions, and is supported by the existence of educational institutions under it which are more complete than other districts/cities in North Maluku (Rajaloa & Hasyim, 2018). The three tertiary institutions in Ternate City are the main focus in producing prospective mathematics teachers who will later serve in the educational environment of the North Maluku region (Hasim et al., 2018).

Universities need to develop strategic steps so that graduates meet competency requirements and are able to compete with university graduates from outside the North Maluku region. In general, the competencies that must be possessed by teachers consist of pedagogic, personality, social and professional competencies, as well as other qualifications that can support the achievement of educational goals (Hadi et al., 2018). Among these competencies, there is one competency that has the most positive effect on student success when participating in learning, namely pedagogical competence (Lestari et al., 2018; McCormack et al., 2006; Van der Heijden et al., 2015). Pedagogical competence absolutely must be owned by every teacher of a particular subject, because that will differentiate them from teachers of other subjects (Akbar, 2021). In addition, pedagogic competence is a basic competency that is a requirement and must be possessed by professionally certified teachers (Lubis, 2018).

The opinions above show the importance of pedagogical competencies possessed by prospective teachers, including students of the mathematics education study program. Pedagogic competence is a competency that is closely related to knowledge and mastery of teaching materials (Saud, 2013). It can also be seen as the teacher's ability to develop a

149

curriculum according to the subject being taught (Wahyudi, 2012). Lubis (2018) argues that a teacher's pedagogical competence will be demonstrated by his ability to deliver material during the learning process. Thus the pedagogic ability of a teacher or prospective teacher of mathematics will be achieved if they have good mastery of the mathematics material itself.

Prospective mathematics teachers receive strengthening of pedagogical competence from several courses delivered by supporting lecturers, one of which is basic mathematics. Basic mathematics courses are of concern to researchers because they are used as a prerequisite if students want to take lectures in the next semester. Apart from that, through this course students will get basic materials such as sets, logic, and proof in mathematics, which these materials will be taught to students at the elementary to high school levels. Researchers are of the view that if mathematics education students fail or are incompetent in basic mathematics courses it will have an impact on: (1) obstacles in attending further lectures; (2) has low pedagogical competence when he acts as a mathematics teacher.

The condition of the Covid-19 pandemic some time ago had an indirect impact, one of which was in the education sector (Aeni, 2021). This pandemic condition has implications for learning in higher education mathematics education study programs in Ternate City. Learning that initially runs normally offline must be adjusted

according to the conditions of the place and time that allow it to be reached by students. In general, the learning processes that can be carried out during a pandemic can be grouped into 3 (three) models, namely: (1) learning in the classroom by applying physical distancing; (2) learning by applying a hybrid model, and; (3) learning by relying on online instruction (Iglesias-Pradas et al., 2021). Implementation of learning with various kinds of adjustments due to the government's Large-Scale Social Restrictions (PSBB) program policy certainly experienced several obstacles. Lecturers, including teachers of basic mathematics courses, need to conduct a study of the difficulties experienced by students while participating in learning during the PSBB period. For this purpose the researcher conducted preliminary research in the STKIP Kie Raha mathematics education study program environment. STKIP Kie Raha was chosen with the consideration of being the only provider of the mathematics education study program from elements of private tertiary institutions in the City of Ternate, which can be assumed to have more limited supporting facilities for online learning compared to Khairun University and IAIN Ternate which receive financial support from the Indonesian government.

The results of the preliminary research conducted by Saleh (2020)

150

showed that students of the STKIP Kie Raha mathematics education study program experienced obstacles in the form of an unstable internet network when learning online, then as anticipation students prefer asynchronous learning methods (Saleh, 2020). Through the asynchronous learning method, students can relatively learn independently by interacting with each other and can access material from places and times that can be arranged more flexibly (Amiti, 2020; Lim, 2017; Watts, 2016). The application of asynchronous learning certainly requires supplements or supporting devices in the form of electronic teaching materials which can later be accessed by students from the desired place and time. Then arose the need to develop electronic devices containing learning materials for students of mathematics education study programs in tertiary institutions in Ternate City, especially at STKIP Kie Raha. LLDIKTI Region XII Maluku and North Maluku provided recommendations to lecturers to develop teaching materials in the form of electronic modules or e-modules (delivered at the 2018 Higher Education Training & Teaching Material Preparation session). E-modules are electronic teaching materials that contain material, methods and evaluation tests whose format is arranged in such a way and systematically so that students can study them independently (Fajri, 2018; Kurniati, 2016; Tjiptiany et al., 2016). One of the benefits of e-modules mentioned by Ashfahani (2016) is that it makes it easier for students to learn without a lecturer. Herdiawan et al. (2022) states that e-modules are suitable for learning starting from the Junior High School (SMP) level to tertiary education. The implementation of the mathematics e-module by Saleh & Triyono, 2022) is proven to be able to increase the activity and learning achievement of mathematics education students. The opinions above were used as material for consideration for researchers to develop e-modules as an alternative solution to the obstacles faced by STKIP Kie Raha students in introductory basic mathematics lectures. This plan was also supported by the results of interviews with 7 lecturers of the STKIP Kie Raha Mathematics Education Study Program who stated the need to immediately develop special electronic modules for introductory basic mathematics courses.

The characteristics of the developed e-module must be able to fulfill several needs, namely: (1) increasing the pedagogical competence of mathematics education students, and; (2) can be accessed in unstable internet conditions or even without internet. So the focus of this research is to produce e-modules with certain criteria which can later be used to support the asynchronous learning method according to the conditions of mathematics education students in Ternate City Higher Education.

RESEARCH METHODS

The purpose of this research is to produce e-modules with valid and practical criteria to support asynchronous learning in basic mathematics courses. The specially developed e-module will be used by students from the STKIP Kie Raha-Ternate Mathematics Education study program. The research method used to achieve the goal is Research and Development (R&D). The research steps taken in the R&D method follow the flow and stages of the development model or product improvement model which is used as a reference, then an effectiveness test is carried out on the product that has been developed or improved (Gall et al., 1996; Sugiyono, 2013; Sugiyono, 2014; Sukmadinata, 2007). The development model or product improvement model that is relevant as a reference in this study is the ADDIE model, which this model has been used to design and develop several offline and online-based learning media in previous studies (Anggraeni, 2019; Setiawan et al., 2020; Triyono, 2019; Triyono et al., 2022). The stages of the ADDIE model and details of the activities carried out in this study are presented in Figure 1.
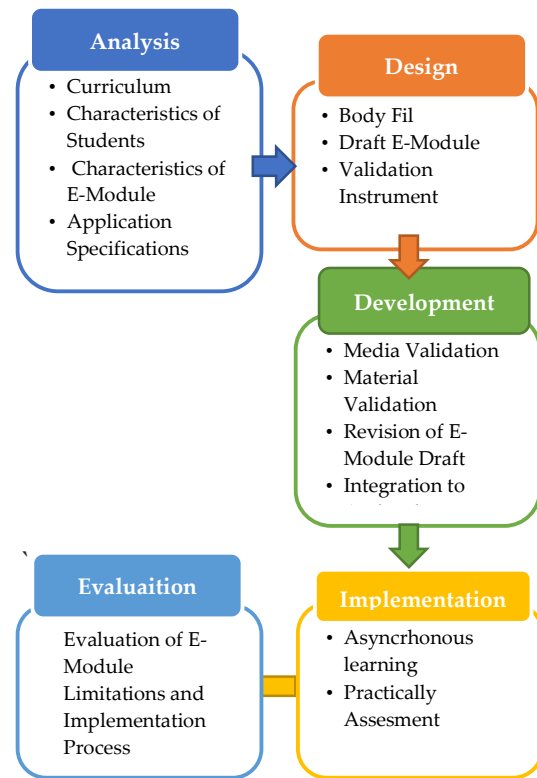

Figure 1. Stages of Implementing the ADDIE Model
(adaptation from Molenda, 2015)

Figure 1 shows the 5 stages in the ADDIE model and details the activities that must be carried out to achieve the research objectives. The Analysis phase consists of: (1) curriculum analysis; (2) analysis of student characteristics; (3) analysis of e-module characteristics, and; (4) analysis of application specifications used. The Design phase consists of: (1) compiling the body contents of the e-module, (2) drafting the e-module, and; (3) preparation of validation instruments. The Development stage consists of: (1) material validation; (2) media validation; (3) revision of the e-module draft, and; (4) Integration of

152

e-modules into applications. The Implementation phase consists of: (1) implementing e-modules in asynchronous learning, and; (2) practicality assessment by students. The evaluation stage is a reflection activity on the weaknesses of the e-module and the implementation process.

The research subjects involved consisted of; 1 measurement expert who acts as a research instrument validator; 2 learning technology experts who act as media validators, 2 math learning experts who act as material validators; 1 IT expert in charge of integrating the draft e-module into the application, and; 11 STKIP Kie Raha-Ternate students who will be respondents in the implementation and practicality test stages. Research data were collected using media validation sheet instruments, material validation sheets, and practicality response questionnaires.

Media validators, material validators, and students provide assessments based on the scoring guidelines developed by Likert (1932) as presented in Table 1.

The results of the assessment were then analyzed until it was concluded that the developed e-module met the valid and practical criteria. Analysis of the validity and practicality of the e-module was carried out according to the steps developed by (Widoyoko, 2012). *The first* is to tabulate the score of the assessment results of media experts and material experts. *The second* is calculating the average score of the results of the tabulation assessment using the average formula (Riduwan, 2011). *The third* is the classification of the results of calculating the average score based on the criteria for the level of validity. The criteria for the validity level of the media and material aspects, as well as the criteria for the practicality of the e-module are determined after calculating the average in the previous step. In the following, the e-module validity level criteria are presented from the media aspect (Table 2) and the material aspect (Table 3), as well as the e-module practicality level criteria (Table 4) specified in this study.

Table 1: Likert Scale Scoring Guidelines

Information	Score
Very Good	5
Good	4
Pretty good	3
Not Good	2

Table 2: Criteria for the Validity Level of the Media Aspect Based on the Average Calculation Results

Interval	Criteria
$\bar{x} > 46,2$	Very Good
$37,4 < \bar{x} < 46,2$	Good

Interval	Criteria
$28,6 < \bar{x} < 37,4$	Pretty Good
$19,8 < \bar{x} < 28,6$	Not Good
$\bar{x} > 19,8$	Very Less Good

(adapted from Widoyoko, 2012)

Table 3: Criteria for the Level of Validity of Material Aspects Based on the Average Calculation Results

Interval	Criteria
$\bar{x} > 84$	Very Good
$68 < \bar{x} < 84$	Good
$52 < \bar{x} < 68$	Pretty Good
$36 < \bar{x} < 52$	Not Good
$\bar{x} > 36$	Very Less Good

(adapted from Widoyoko, 2012)

Table 4: Criteria for the Level of Validity of Material Aspects Based on the Average Calculation Results

Interval	Criteria
$\bar{x} > 50,4$	Very Good
$40,8 < \bar{x} < 50,4$	Good
$31,2 < \bar{x} < 40,8$	Pretty Good
$21,6 < \bar{x} < 31,2$	Not Good
$\bar{x} > 21,6$	Very Less Good

(adapted from Widoyoko, 2012)

The fourth is to draw conclusions on the results of the validator's and student's assessment. E-module is said to be valid if the level of validity of the media and material aspects reaches the minimum criteria of "Good". And e-modules are said to be practical if their practicality level reaches the minimum criteria of "Good".

RESULT AND DISCUSSION

Research activities at each stage of the ADDIE model in this study were completed within 6 months. The following will explain the results of each stage of the research that has been carried out.

ANALYSIS STAGE

The analysis phase begins with an analysis of the curriculum used in the STKIP Kie Raha Mathematics Education Study Program. Through the curriculum analysis process, the researcher knows for certain about the material that must be included in the e-module, namely: (1) the definition of set; (2) set operations, and; (3) Venn diagrams.

Analysis of student characteristics is intended to determine student abilities in accessing the internet and the types of devices used for learning. The analysis was carried out through interviews with 11 students who had attended lectures in the previous semester. Through the process of analyzing student characteristics, researchers obtained data: (1) 100% stated that they experienced problems or had the potential to experience internet network problems while studying from home; (2) 60% access lecture materials using mobile phones only; (3) 40% can access lecture materials using laptops and cellphones, and; (4) all students have mobile devices with the Android operating system, namely platforms/operating systems for mobile devices, especially smartphones based on Linux (Safaat, 2015). Analysis of the characteristics of the e-module is intended to find

154

out specific things that must be accommodated so that they are in accordance with the interests of students as beneficiaries of the implementation of the e-module. So based on the current conditions of students, it can be concluded that e-modules must: (1) be accessible online or offline; (2) support the asynchronous learning process, and; (3) easily accessible via all types of mobile phones or mobile friendly characters.

Analysis of e-module application specifications is intended to find out which applications are most suitable for the availability of devices owned by students, namely mobile phones with the Android operating system. Based on the literature review, the researcher views the Android Kitkat Version 4.4 application as the most suitable for current student needs. Supporting reasons include: (1) more friendly to devices with modest specifications (Safaat, 2015); (2) Android applications are generally equal, that is, they have equal access to different mobile phone capabilities (Nasruddin Safaat, 2015); (3) having the ability to increase smartphone memory so that it can increase the responsibility of the touchscreen display (Utomo, 2012; Iriawan, 2012). In addition to these three reasons, previous research has succeeded in developing a learning evaluation test application based on Android Kitkat 4.4 (Wibisono & Menarianti, 2017). So that researchers view the development of e-modules using the Android Kitkat Version 4.4

application has fulfilled all aspects that must be considered before.

DESIGN STAGE

The first activity carried out at the design stage is the preparation of material that will be contained in the body of the e-module which consists of 3 learning activities. The first learning activity contains material: (1) the definition of sets, and (2) types of sets. The second learning activity contains material: (1) various advanced sets, and; (2) venn diagrams. The third learning activity contains material: (1) set slices, and; (2) combined set. These materials are then set forth in a draft e-module which will be prepared in the next step.

Next, the preparation of the e-module draft is carried out. The draft e-module that has been prepared consists of pages: (1) Cover; (2) Preface; (3) Table of Contents; (4) Instructions for Use; (5) Concept Map; (6) Torso; (7) Problem Practice; (8) Competency Test; (9) Answer Key; (10) Glossary, and (11) Compiler's Profile. An example of an e-module draft display is shown in Figure 2.

155

The next research activity was the preparation of media validation sheet instruments, material validation sheets, and practicality response questionnaires. The prepared media validation sheet contains aspects; (1) presentation, and; (2) graphics. The material validation sheet that has been prepared contains aspects of: (1) content feasibility; (2) language, and; (3) presentation feasibility. The practicality response questionnaire that has been prepared contains aspects of: (1) language; (2) presentation, and; (3) graphics. These instruments were then consulted with experts on learning measurement and evaluation. The experts involved at this stage are Dr. Suprapto who is an education expert from a government agency in Bantul, Yogyakarta. The results of the consultation show that the validation sheet and practicality questionnaire have fulfilled all aspects of measurement so that they can be directly used to assess the product being developed.

DEVELOPMENT STAGE

At the development stage, media experts and material experts validated the draft e-module. Furthermore, the researcher revised according to the

suggestions for improvement given by the validators.

The media experts involved at this stage are learning technology experts from Ahmad Dahlan University. The results of the assessment of the two media experts are shown in Table 5.

Table 5: Score of Media Validation Results

Validator	Score
Validator 1	41
Validator 2	46
Average Score	**43,5**

Table 5 shows the average score of the results of the media expert's assessment, which is equal to 43.5. Based on Table 2, the average score reaches the criteria for a "Good" validity level when viewed from the media aspect.

Then validation was carried out by material experts from Ahmad Dahlan University and experts in learning mathematics from STKIP Kie Raha. The results of the validation of the two material experts are presented in Table 6.

Tabel 6: Scores of Material Validation Results

Validator	Score
Validator A	81
Validator B	82
Average Score	**81,5**

Table 6 shows the average score of the material expert's assessment, which is equal to 81.5. Based on Table 3, the

156

average score of these results reaches the "Very Good" validity level criterion when viewed from the material aspect.

The draft e-module was then revised following the suggestions for improvement from the validators. Suggestions for improvement from media experts are: (1) the cover of the module is expected to contain illustrations of set material so that it is in accordance with the contents of the e-module; (2) the view of the concept map page is clarified, and; (3) the author's profile page needs to be reduced in variation. As for suggestions for improvement from material experts, namely: (1) improvements to the terms and definitions used, and; (2) improvement in writing systematics. Some examples of revision results are shown in Figure 3.

Figure 3: Results of the Revised E-Module Draft

The draft e-module that has gone through the validation and revision process is then integrated into the Android application "Kitkat Version 4.4". In this process the researchers involved an IT expert named Alan Pamungkas, S.T who is an Android Developer from PT Widya Kreasi

Bangsa. This integration process takes 1 hour, after which the e-module can be implemented.

IMPLEMENTATION STAGE

The implementation phase involved 11 semester 2 students of the STKIP Kie Raha Mathematics Education Study Program. All students can download and install e-modules using internet quota on their respective cell phones without experiencing problems and are ready to implement e-modules in the learning process which are designed asynchronously. Supporting lecturers plan learning in 2 offline meetings and 1 online meeting. Offline meetings are intended to test whether the material in the e-module can be accessed properly without internet facilities. Meanwhile, online meetings are intended to test the opposite. Until this implementation stage it can be shown that all material in the e-module can be accessed online or offline without any problems.

Students then provide assessments and suggestions for improvements to the practical aspects of the e-module by filling out a media practicality questionnaire. The results of student assessments are presented in Table 7.

Table 7. Results of the E-Module Practicality Assessment

No	Student Code	Score
1	S1	51
2	S2	50
3	S3	51

157

4	S4	53
5	S5	53
6	S6	52
7	S7	52
8	S8	49
9	S9	49
10	S10	51
11	S11	51
	Amount	**562**
	Average Score	**51,1**

Table 7 shows the average score of the results of the practicality aspect assessment by students, which is 51.5. Based on Table 4, the average score reaches the practicality level criteria of "Very Good". As for suggestions for improvement from students related to the need for an answer sending feature in the e-module. This is necessary for students who wish to submit quiz answers in real time.

EVALUATION STAGE

Implementation of e-modules in asynchronous learning goes well according to the asynchronous learning plan. All material in the e-module can also be accessed smoothly, both using internet facilities and without the internet. The absence of an answer submission feature basically does not interfere with the asynchronous learning process because students can send quiz answers via email or WhatsApp. As for e-module improvements that focus on developing quiz answer delivery features, this will be carried out in the next research and development.

Based on the specified stages, this research can be said to have been completed. Through the analysis phase, it can be shown that there is a need for e-modules in basic mathematics courses which are very urgent within the STKIP Kie Raha Mathematics Education Study Program. The developed e-module meets student expectations, namely that it can be accessed without the internet so that it can be a solution for unstable internet conditions in the City of Ternate. The validation results from media experts with an average score of 43.5 indicate that the e-module being developed has a "Good" level of validity from the media aspect, and the validation results from material experts with an average score of 81.5 indicate that the e- the module has a "Very Good" validity level from the material aspect. Thus it can be concluded that the developed e-module meets the valid criteria from the media aspect and the material aspect. Through the implementation phase it can be shown that the e-module has no problems when it is applied in asynchronous learning. Then from the results of the student assessment, an average score of 51.5 was obtained which indicated that the e-module had a practical level of "Very good" when applied in asynchronous learning. Based on the explanation above, the researcher has been able to show that the developed e-module meets valid and practical criteria. The results of this research and development are also in line with the development of e-modules carried

out by previous researchers (Amalia & Sujatmiko, 2022; Dewi & Lestari, 2020; Jamaluddin, 2018; Minan & Ekohariadi, 2022; Sholeh & Prapanca, 2023). Some of the advantages of the "Android Veri Kitkat 4.4"-based e-module being developed include: (1) it is easily accessible by many mobile devices even though it has a normal standard, and; (2) simple and very practical to use by students. The thing that needs to be considered is that the e-module is not ready for use by students who use cellphones with an IOS system, for example Apple-branded devices.

CONCLUSION

The development of the "Android Kitkat 4.4" application-based e-module has been completed according to the stages specified in the ADDIE model. Based on the validation results of media experts and material experts, it can be shown that the developed e-module meets the valid criteria. After implementing asynchronous learning, it can be shown that all material in the e-module can be accessed without problems by students. Furthermore, based on the results of student assessments, it can be shown that the e-module meets the "Very Good" practicality criteria. Thus the development of an application-based e-module "Android Kitkat 4.4" which is intended to support asynchronous learning has achieved the stated goals.

REFERENCES

Aeni, N. (2021). Pandemi covid-19: Dampak kesehatan, ekonomi, & sosial. *Jurnal Litbang: Media Informasi Penelitian, Pengembangan Dan IPTEK*, *17*(1), 17–34. https://doi.org/10.33658/jl.v17i1.249

Akbar, A. (2021). Pentingnya kompetensi pedagogik guru. *JPG: Jurnal Pendidikan Guru*, *2*(1), 23–30. https://doi.org/10.25134/equi.v18i2.4154

Amalia, I., & Sujatmiko, B. (2022). PENGEMBANGAN E-MODUL BERBANTUAN FLIPBOOK BERBASIS PJBL GUNA MENINGKATKAN HASIL BELAJAR SISWA PADA MATA PELAJARAN TEKNIK ANIMASI 2D DAN 3D KELAS XI MULTIMEDIA (STUDI KASUS: SMKN 2 SINGOSARI). *IT-Edu: Jurnal Information Technology and Education*, *7*(1), 92–99. https://ejournal.unesa.ac.id/index.php/it-edu/article/view/50147

Amiti, F. (2020). Synchronous and asynchronous E-learning. *European Journal of Open Education and E-Learning Studies*, *5*(2).

http://dx.doi.org/10.46827/ejoe.v5i2.3313

Anggraeni, L. (2019). Design Of Mathematics Module Based On Guided Discovery To Train Student Creativity. *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH*, *8*(11). www.ijstr.org

Ashfahani, A. (2016). Peningkatan Pemahaman Materi AutoCad Melalui Pembelajaran Menggunakan Modul Bergambar Pada Siswa SMK Muhammadiyah 3 Yogyakarta Jurusan Teknik Gambar Bangunan. *E-Jurnal Skripsi Program Studi Teknologi Pendidikan*, *5*(8), 345–359. https://journal.student.uny.ac.id/index.php/fiptp/article/view/5540

Dewi, M. S. A., & Lestari, N. A. P. (2020). E-modul interaktif berbasis proyek terhadap hasil belajar siswa. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *4*(3), 433–441. https://doi.org/10.23887/jipp.v4i3.28035

Dewi, Z. R. (2019). Penataaan Guru Mata Pelajaran Matematika SMA Negeri di Provinsi Jawa Timur. *Inspirasi Manajemen Pendidikan*, *7*(1). https://ejournal.unesa.ac.id/index.php/inspirasi-manajemen-pendidikan/article/view/28420

Fajri, Z. (2018). Bahan Ajar Tematik Dalam Pelaksanaan Kurikulum 2013. *PEDAGOGIK: Jurnal Pendidikan*, *5*(1), 100–108. https://doi.org/10.33650/pjp.v5i1.226

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction*. Longman Publishing.

Hadi, R. I., Suhirwan, S., & Simatupang, H. (2018). Implementasi Undang-Undang Republik Indonesia Nomor 14 Tahun 2005 Tentang Guru Dan Dosen (Studi Kasus Kompetensi Tenaga Pendidik di Wing Pendidikan Teknik dan Pembekalan Kalijati Dalam Mempersiapkan Sumber Daya Manusia Pertahanan TNI AU Tahun 2017). *Strategi Pertahanan Udara*, *4*(3). https://doi.org/10.33172/jspu.v4i3.339

Hasim, R., Rajaloa, N. I., & Yusuf, M. (2018). Manajemen Sumberdaya Manusia Tenaga Pendidik Oleh Dinas Pendidikan Kota Ternate. *Humano: Jurnal Penelitian*, *8*(2), 123–136. http://dx.doi.org/10.33387/hjp.v8i2.585

Herdiawan, R. M. L., Triyono, A., & Wibowo, T. (2022). ANALISIS KEBUTUHAN E-MODUL BERBASIS FLIPBOOK UNTUK MEMFASILITASI BERPIKIR KRITIS MATEMATIS SISWA KELAS TUJUH SMP ISLAM AL AZHAR YOGYAKARTA. *Seminar Nasional Pendidikan Sultan Agung IV*, *4*(1). http://jurnal.unissula.ac.id/index.php/sendiksa/article/view/27383

Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J., & Prieto, J. L. (2021). Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study. *Computers in Human Behavior*, *119*, 106713. https://doi.org/10.1016/j.chb.2021.106713

Jamaluddin, M. (2018). Pengembangan E-Modul Interaktif Berbasis Proyek Pada Mata Kuliah Sistem Evaluasi Pembelajaran Matematika. *APOTEMA: Jurnal Program Studi Pendidikan Matematika*, *4*(2), 57–63. http://publikasi.stkippgri-bkl.ac.id/index.php/APM/article/view/296

Kurniati, A. (2016). Pengembangan modul matematika berbasis kontekstual terintegrasi ilmu keislaman. *Al-Khwarizmi: Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, *4*(1), 43–58. https://doi.org/10.24256/jpmipa.v4i1.251

Lestari, W., Pratama, L. D., & Jailani, J. (2018). Implementasi Pendekatan Saintifik Setting Kooperatif Tipe STAD Terhadap Motivasi Belajar Dan Prestasi Belajar Matematika. *AKSIOMA: Jurnal Matematika Dan Pendidikan Matematika*, *9*(1), 29–36. https://doi.org/10.26877/aks.v9i1.2332

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*.

Lim, F. P. (2017). An analysis of synchronous and asynchronous communication tools in e-learning. *Advanced Science and Technology Letters*, *143*(46), 230–234. https://www.researchgate.net/profile/Francis-Lim-3/publication/313673458_An_Analysis_of_Synchronous_and_Asynchronous_Communication_Tools_in_e-Learning/links/5c441688299bf12be3d55625/An-Analysis-of-Synchronous-and-Asynchronous-Communication-Tools-in-e-Learning.pdf

Lubis, H. (2018). Kompetensi Pedagogik Guru Profesional. *Best Journal (Biology Education, Sains and Technology)*, *1*(2), 16–19. https://doi.org/10.30743/best.v1i2.788

McCormack, A., Gore, J., & Thomas, K. (2006). Early career teacher professional learning. *Asia-Pacific Journal of Teacher Education*, *34*(1), 95–113. https://doi.org/10.1080/13598660500480282

Minan, D. A., & Ekohariadi, E. (2022). PENGEMBANGAN MEDIA PEMBELAJARAN E-MODUL BERBASIS MOBILE GLIDEAPPS PADA MATA PELAJARAN KEJURUAN KELAS X DKV SMK NEGERI 1 CERME GRESIK. *IT-Edu: Jurnal Information Technology and Education*, *7*(1), 36–45.

https://ejournal.unesa.ac.id/index.php/it-edu/article/view/49048

Molenda, M. (2015). In search of the elusive ADDIE model. *Performance Improvement*, *54*(2), 40–42. doi: 10.1002/pfi.4930420508

Ika, M. (2014). *Strategi Rekrutmen Guru Di Man Insan Cendekia Serpong*. https://repository.uinjkt.ac.id/dspace/handle/123456789/24818

Iriawan. (2012). *Membuat aplikasi android untuk orang awam*. Palembang: Maxikom

Rajaloa, N. I., & Hasyim, R. (2018). Manajemen Perencanaan dan Rekrutmen Tenaga Pendidik Oleh Dinas Pendidikan Kota Ternate. *Edukasi*, *16*(1). https://ejournal.unkhair.ac.id/index.php/edu

Riduwan, S. (2011). Pengantar Statistika Untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi, dan Bisnis. *Cetakan Ke-4 Bandung: Alfabeta*.

Safaat, N. (2015). *Pemograman Aplikasi Mobile Smartphone Dan Tablet PC Berbasis Android*. Bandung: Informatika Bandung.

Saleh, R. R. M. (2020). Analysis and design module based on PJBL to improve mathematical communication skills. *Journal of Advanced Research in Dynamical and Control Systems*, *12*(7), 493–501.

Saleh, R. R. M., & Triyono, A. (2022). Implementasi E-Modul Berbasis Project Based Learning Untuk Meningkatkan Aktivitas Dan Hasil Belajar Mahasiswa STKIP Kusuma

Negara. *JIMAT: Jurnal Ilmiah Matematika*, *3*(1), 23–33. http://jurnal.stkipkieraha.ac.id/index.php/jimat/article/view/328

Saud, U. S. (2013). *Pengembangan Profesi Guru.* Bandung. Alfabeta.

Setiawan, A. H., Suparman, S., Suhendar, A., Machmud, T., Abbas, S., & Pamuti, P. (2020). Analysis and Design of Modules to Generate Students' Mathematical Communication Skills through Problem Based Learning Models. *Universal Journal of Educational Research*, *8*(12A), 7572–7582. https://doi.org/10.13189/ujer.2020.082543

Setiawan, Y. E. (2020). *Sistem Pendukung Pengambilan Keputusan Rekrutmen Guru Menggunakan Logika Fuzzy Tahani*. https://doi.org/10.30598/barekengvol14iss2pp253-266

Sholeh, A. N., & Prapanca, A. (2023). PENGEMBANGAN MEDIA PEMBELAJARAN BERBASIS VIDEO ANIMASI INFOGRAFIS PADA MATA PELAJARAN TEKNIK ANIMASI 2 DIMENSI DAN 3 DIMENSI KELAS XI MULTIMEDIA DI SMKN 1 DRIYOREJO. *IT-Edu: Jurnal Information Technology and Education*, *8*(1), 17–25. https://ejournal.unesa.ac.id/index.php/it-edu/article/view/50702

Sugiyono, D. (2013). *Metode penelitian pendidikan pendekatan kuantitatif,*

kualitatif dan R&D. https://digilib.unigres.ac.id/index.php?p=show_detail&id=43

Sugiyono, P. D. (2014). *Metode Penelitian Kombinasi... - Google Scholar.* https://scholar.google.com/scholar?hl=id&as_sdt=0%2C5&q=Sugiyono%2C+P.+D.+%282014%29.+Metode+Penelitian+Kombinasi+%28Mixed+Methods%29%28Sutopo.+Alfabeta%2C+CV%29.&btnG=

Sukmadinata, S. (2007). Metode Penelitian Pendidikan Cet. III; Bandung: PT. *Remaja Rosdakarya.*

Tjiptiany, E. N., As'ari, A. R., & Muksar, M. (2016). Pengembangan modul pembelajaran matematika dengan pendekatan inkuiri untuk membantu siswa SMA kelas X dalam memahami materi peluang. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(10), 1938–1942. http://dx.doi.org/10.17977/jp.v1i10.6973

Triyono, A. (2019). Inquiry-Based Worksheet Design To Improve Critical Thinking Of Students In Indonesia. *Int. J. Sci. Technol. Res*, *8*, 1183–1187. https://www.ijstr.org/final-print/oct2019/Inquiry-based-Worksheet-Design-To-Improve-Critical-Thinking-Of-Students-In-Indonesia.pdf

Triyono, A., Charitas, R., Prahmana, I., Wibowo, T., & Kusuma, A. P. (2022). Developing Inquiry-Based Worksheet to Explore The Mathematics Critical Thinking for Seventh Grader Students. *Jurnal Mercumatika : Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *6*(2), 10–19. https://doi.org/10.26486/JM.V6I2.2363

Utomo, E. P. (2012). From Newbie to Advanced Mudahnya Membuat Aplikasi Android. *Edisi I: Yogyakarta. CV Andi Offset*, 1–2.

Van der Heijden, H., Geldens, J. J. M., Beijaard, D., & Popeijus, H. L. (2015). Characteristics of teachers as change agents. *Teachers and Teaching*, *21*(6), 681–699. https://doi.org/10.1080/13540602.2015.1044328

Yusdikasari, V. (2015). *Rekrutmen dan Seleksi Guru di SMP PGRI 1 Bekasi* (Doctoral dissertation, UNIVERSITAS NEGERI JAKARTA). http://repository.unj.ac.id/29805/1/SKRIPSI%20VIVI%20YUSDIKASARI%201445115201.pdf

Wahyudi, I. (2012). *Panduan Lengkap Uji Sertifikasi Guru. jakarta: PT Prestasi Pustakatya.*

Watts, L. (2016). Synchronous and asynchronous communication in distance learning: A review of the literature. *Quarterly Review of Distance Education*, *17*(1), 23. https://www.proquest.com/openview/f83c30d3f7e7d1cd69754d1fa52eaff5/1?pq-origsite=gscholar&cbl=29705

Wibisono, A., & Menarianti, I. (2017). *PENGEMBANGAN APLIKASI SMARTPHONE ASSISTED*

TEST BERBASIS ANDROID KITKAT 4.4. 4.

Widoyoko, E. P. (2012). *Teknik penyusunan instrumen penelitian*. Yogyakarta: Pustaka Pelajar.