DEVELOPMENT OF STEM-BASED DIGITAL POCKETBOOK ON SPLDV MATERIAL USING THE ADDIE MODEL: APPLICATION IN ONLINE LEARNING ENVIRONMENTS

Komarudin[1*], Suherman[2], Laila Puspita[3]
[1]Pendidikan Matematika, Universitas Islam Negeri Raden Fatah Palembang, Indonesia
[2,3]Pendidikan Matematika, Universitas Islam Negeri Raden Intan Lampung
[2] Institute of Education, University of Szeged, Hungary
*e-mail: komarudin@radenfatah.ac.id

Abstract

This study aims to assess the feasibility, teacher and student responses, and effectiveness of the STEM-based digital pocketbook on the topic of Systems of Linear Equations in Two Variables (SPLDV). The subjects of this research were junior high school students in Bandar Lampung. Data collection instruments included questionnaires distributed to subject matter experts, media experts, and student respondents. The method in this research uses the ADDIE model which consists of 5 stages, namely: Analysis, design, development, implementation, and evaluation. The findings indicate that the developed learning media are highly suitable and engaging for mathematics instruction, particularly concerning SPLDV topics. However, due to the global COVID-19 pandemic, the research did not progress to the implementation phase, thereby precluding the effectiveness testing of the STEM-based digital pocketbook.

Keywords: Digital Pocket Book; STEM learning; System of linear equations in two variables.

Abstrak

Penelitian ini bertujuan untuk mengetahui kelayakan, respon guru dan siswa, dan efektivitas Buku Saku Digital Berbasis STEM pada materi SPLDV. Subyek penelitian ini adalah siswa SMP di Bandar Lampung. Instrumen pengumpulan data yang digunakan berupa angket ahli materi, ahli media dan angket respon siswa. Metode dalam penelitian ini menggunakan model ADDIE yang terdiri dari 5 tahap yaitu: Analysis, design, development, implementation, dan evaluation. Adapun hasil penelitian menyatakan bahwa media pembelajaran yang dikembangkan sangat layak dan sangat menarik untuk digunakan dalam pembelajaran matematika, khususnya materi SPLDV. Adanya COVID-19 yang terjadi secara global menyebabkan penelitian ini tidak sampai pada tahap implementasi. Sehingga uji efektivitas buku saku digital berbasis STEM tidak dapat dilaksanakan.

Kata kunci: Buku saku digital; Pembelajaran STEM; Sistem persamaan linear dua variabel.

INTRODUCTION

The development of science and technology has progressed very rapidly in the current era of globalization (Hartanto, Triyanto, Yuliandari, & Ariana, 2020; Maslaha & Suryani, 2018; Septina, Farida, & Komarudin, 2018). Advances in science and technology have provided new demands for aspects of life, one of which is the education system (Ekawati, Anggoro, & Komarudin, 2019; Rusmaini, 2017; Yahya, 2006). Education is a learning process to actively develop one's potential and skills (Asiah, 2016; Wibawa, 2017). Education serves to transmit or transfer culture, teach social roles and develop personality (Latif, 2016; Nasution, 2017).

Education has a great influence on human life in order to advance the life of a nation (Rodiawati & Komarudin, 2018). The law also explains that every citizen has the right to quality education (Supriadi & Damayanti, 2016). Therefore, the world of education is very important for a person's personal life as a citizen (Mardiah & Rinaldi, 2018). To support the quality of the education process, learning media is needed.

Learning media is a means of teaching and learning process that influences the achievement of learning objectives well (Nadeak & Naibaho, 2019; Saripudin, Sari, & Mukhtar, 2018). Learning media that are often used today are still limited to printed books, therefore it is necessary to develop learning media in accordance with technological advances that are developing (Komarudin, Thahir, & Sholekan, 2019). The development of learning media in accordance with current advances in science and technology, one of which is learning media in the form of digital pocketbooks. Digital pocketbooks are electronic books that are practical to carry anywhere and read anytime and do not require large storage space (Nurmala, Izzatin, & Mucti, 2019; Saputra & Ekawati, 2018). Digital pocketbooks are usually in PDF format, but digital pocketbooks are more sophisticated and attractive when assisted by an android application, namely appypie (Ambarwati, 2017). Appypie is a website that has presented templates in the creation of android applications easily and attractively and does not require special abilities in computer programming, making it easy to operate on smartphones (Rihandoko, 2018). The advantages of appypie are that it can include learning materials in the form of text, links, images, videos and interactive quizzes (Astuti, Dasmo, & Sumarni, 2018; Hafidz, Sumardi, & Komaro, 2019).

Previous research on the development of digital pocketbooks has been carried out several times, including the development of digital pocketbooks to increase student interest and learning outcomes (Nurmala et al., 2019), The development of digital pocketbooks, as supporting teaching materials on pph article 21 material (Yaqin, 2016), as learning media for health law (Putri & Sumbawati, 2017), in terms of student reading interest (Setyono, Karmin, & Wahyuningsih, 2013), to increase knowledge of sports nutrition (Festiawan & Arovah, 2020), based on local wisdom as a learning resource (Fitri, Izzatin, & Ferryansyah, 2019). Based on the above research, it appears that no research has been conducted that combines digital pocketbooks with STEM education. So, this research is intended to develop a STEM-

based digital pocketbook to develop students' mathematical communication skills. The novelty in this research is the development of a STEM-based digital pocket book on Systems of Linear Equations in Two Variables (SPLDV) which is applied in online learning.

METHODS

The type of research conducted is research and development (R&D). This research uses the ADDIE model which consists of 5 stages, namely analysis, design, development, implementation, and evaluation (Tegeh & Kirna, 2013). Research and development in the field of education is a type of research that aims to develop and validate educational and learning products. The ADDIE stages are illustrated in the following Figure 1:
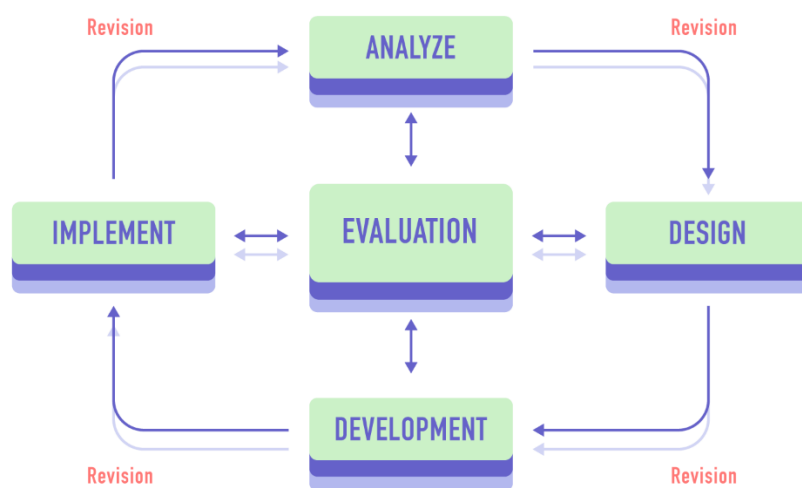

Figure 1. Model ADDIE Stage Flow chart

Each phase plays a crucial role in the development process of digital pocketbooks. The Analysis phase involves identifying learning needs and collecting necessary data for the development process. During the Design phase, planning of the digital pocketbook's structure and content is conducted, including the development of evaluation instruments to measure validity, teacher and student responses, and the effectiveness of the developed learning media. The Development phase entails creating digital pocketbook content based on the established design, such as material composition, multimedia usage, and interactive media development, while ensuring that the content adheres to predefined validity standards and teacher and student responses. The Implementation phase provides an opportunity to test the effectiveness of the digital pocketbook in real learning contexts. Evaluation, a crucial

stage, involves comprehensive assessment of the validity and reliability of the digital pocketbook through data collection at each stage.

The validation process for the data analysis method engaged three experts in the fields of materials, media, and social studies. These experts evaluated the method using a Likert scale with values ranging from 4 (excellent) to 1 (poor). Subsequently, the questionnaire responses gathered from the expert validation were classified based on the criteria outlined in Table 1.

Table 1. Validation Criteria (Modified)

Quality Score	Validity Criteria	Description
$3,25 < \bar{x} \leq 4,00$	Valid	No revision
$2,50 < \bar{x} \leq 3,25$	Moderate	Partial revision
$1,75 < \bar{x} \leq 2,50$	Less valid	Partial revision & material review
$1,00 < \bar{x} \leq 1,75$	Invalid	Total revision

Products that have been validated by experts are tested to determine their appeal. In this product trial, students are given the product and then given a student response questionnaire. The questionnaire results obtained from students were then adjusted to the interpretation in Table 2:

Table 2. Criteria for Attractiveness Test (Modified)

Skor Kualitas	Kriteria
$3,25 < \bar{x} \leq 4,00$	Very Interesting
$2,50 < \bar{x} \leq 3,25$	Interesting
$1,75 < \bar{x} \leq 2,50$	Less Attractive
$1,00 \leq \bar{x} \leq 1,75$	Very Unattractive

RESULTS AND DISCUSSION

Results

The results of the research produced a STEM-based digital pocket book on SPLDV material in online learning. The research process employed the ADDIE model, encompassing five distinct stages. Detailed data regarding the outcomes of each stage within the research procedures are presented as follows:

Analysis

The analysis phase represents the primary stage in this study. Within this phase, a needs analysis, curriculum analysis, and examination of student characteristics were conducted to guide the development process of learning media. Below is an explanation of the outcomes of the LKPD development during the analysis phase:

➢ Identifying student needs

At this stage, a needs analysis is conducted to identify the gap between the current abilities of the students and the expected competencies. The result is a list of needs that the LKPD must meet to help students achieve the learning objectives.

➢ Curriculum analysis

The LKPD developers analyze the existing curriculum, competency standards, and achievement indicators. The outcome is a mapping of the competencies to be achieved through the LKPD, ensuring that the content presented is relevant and in line with the curriculum.

➢ Learning Material Analysis:

Relevant materials related to the expected competencies are analyzed to ensure their content is suitable for the students' needs. The result is an outline or framework of the material to be presented in the LKPD, including key topics and their sequence.

➢ Analysis of Student Characteristics:

Understanding the characteristics of the students, such as age, skill level, learning styles, and background knowledge. The outcome is a student profile that serves as a basis for tailoring the content and presentation methods of the LKPD to be more effective and engaging for the students.

➢ Development Plan for LKPD:

Based on all the above analyses, a development plan for the LKPD is created, including its structure, format, and content delivery strategies. The result is a detailed work plan for developing the LKPD, including schedules and responsibilities of each team member

Design

In the Design phase, the framework for the digital pocketbook and the material presentation design are created to provide a clear picture of how the digital pocketbook will

be developed. The results of the LKPD development research at this stage encompass several key aspects:

➢ Digital Pocketbook Framework Development

- Goals and Objectives: Determining the specific goals of the digital pocketbook, including the competencies that students are expected to achieve.

- Content Structure: Mapping out the main topics and subtopics to be presented, ensuring a logical and easy-to-follow flow of information.

- Navigation and User Interface: Designing an intuitive interface, including navigation elements such as menus, buttons, and links that facilitate access to various sections of the pocketbook.

➢ Material Presentation Design:

- Format and Presentation Style: Determining the presentation format, such as text, images, videos, and animations, as well as the language style appropriate to the characteristics of the students.

- Multimedia and Interactivity: Integrating multimedia elements and interactive features to enhance student engagement and understanding.

- Activities and Exercises: Designing activities and exercises that support active learning, including assignments, quizzes, and simulations.

Development

The In the Development phase, the framework that was created during the Design phase is validated. This phase includes the creation of a STEM-based digital pocket book on SPLDV material. The concrete learning media is then validated by subject matter and media experts to assess its feasibility. Here is an explanation of the research results in the LKPD development at this stage:

➢ Creation of STEM-Based Digital Pocketbook:

Implementation of the Design Framework: Using the framework designed in the previous phase, the digital pocketbook is developed with the assistance of the Appypie platform. The result is an interactive digital pocketbook ready for validation.

➢ Validation by Subject Matter and Media Experts:

- Content Feasibility: Subject matter experts assess the content of the digital pocketbook to ensure that the material presented aligns with the expected competencies and is scientifically accurate.

- Media Feasibility: Media experts evaluate the technical and design aspects of the digital pocketbook, including user interface, navigation, and the use of multimedia elements. The validation results indicate that the learning media is categorized as "highly feasible" for use.

➢ Testing by Students:

- Level of Appeal: The digital pocketbook is tested by students to measure its level of appeal. This trial includes an evaluation of how students interact with the media, how engaging they find the content, and how effective the media is in aiding their understanding. The testing results show that the digital pocketbook is rated as "highly engaging" by the students.

Overall, the results of the Development phase indicate that the STEM-based digital pocketbook developed with Appypie has been validated and rated as highly feasible by experts and highly engaging by students. This suggests that the digital pocketbook is ready to be used as an effective and engaging learning medium.

Implememtation

The implementation stage is carried out to test the effectiveness of learning media in the form of digital pocketbooks. This cannot be done due to the corona virus disease (COVID-19) that occurs almost all over the world, including student learning at school. Therefore, it is deemed less effective if the implementation stage is carried out online. Due to the policy provided by the mathematics department, researchers only carried out this development up to the stage of testing expert validity and student responses.

Evaluation

Evaluation is the last stage in this development. The evaluation stage in this research and development is applied at each stage of the ADDIE model development. The last evaluation carried out by researchers is to analyze the research data obtained. Based on the analysis that has been done, it shows that the learning media in the form of digital pocketbooks developed are feasible to use and very interesting to use in the learning process.

Discussion

In developing learning media in the form of this digital pocket book, researchers use the ADDIE model. There are several problems behind the development of this learning media found at the analysis stage, namely the absence of the use of pocketbooks for application in the classroom, the low mathematical communication skills of students to study and solve mathematical problems, students have not utilized android properly and have not developed STEM-based digital pocketbook in learning mathematics. After the analysis stage, the next stage is the planning stage. In the first planning stage, the preparation of the digital pocketbook framework is carried out, namely by designing the application icon, the initial opening of the application, compiling the homepage display and determining the menu options on the homepage. Second, the material presentation planning is determining KI and KD and competency achievement, determining material subsections, interactive quizzes, learning videos, sample questions and practice questions presented.

The next stage is the development stage. The development stage is the stage of making media in the form of digital pocketbooks. Learning media that has been made and ready is then validated by material experts and media experts as well as student attractiveness tests. The results of the validation test by material experts obtained an average score of 3.62 and media experts obtained an average score of 3.74 which stated that the learning media was very feasible to use and the student attractiveness test for small groups obtained an average of 3.53 and for large groups obtained an average of 3.77 with very interesting criteria.

The implementation stage should be carried out by testing the effectiveness of learning media in the form of digital pocketbooks. This could not be done due to COVID-19 that occurred almost all over the world, including the learning process of students at school. This is deemed less effective if the implementation stage is carried out online. So that this research and development is only carried out until the student's interest response test stage. The last stage in this research is the evaluation stage. The evaluation stage is carried out after completing the previous four stages. The evaluation carried out aims to improve the weaknesses in the learning media developed.

In line with the research that has been developed, including the development of digital pocketbooks on flat building material, it is declared very feasible to use with an average score of 3.29 by material experts and 3.28 by media experts and a very good student response questionnaire of 3.47 (Fajar, 2019), In addition, the appypie learning media on online marketing was declared very feasible to use with a percentage of 90% by material experts and 85.5% by media experts and the student response questionnaire was very feasible with a percentage of 93% for limited trials and 94% for field trials (Diantari, 2019), as a medium for learning economic mathematics, it was stated that the pocketbook media was very valid with an average score of 4.13 (Pramika & Widalismana, 2018), In addition, in increasing students' interest in learning, it is stated that the digital pocketbook learning media is feasible to use with the assessment of material experts obtained a total score of 31 with a percentage of 86.11% and media experts obtained a total score of 28 with a percentage of 77.77% and a response questionnaire obtained a percentage of 75% or 60 students in the minimum high category (Nurmala et al., 2019). The results of the study on the use of pocket book as a health promotion media stated that the pocket book media was feasible and very feasible with the assessment of material experts and media experts obtained a percentage of 75%-100% (Ahmad, Adi, & Gayatri, 2017).

Based on research that has been done before, it shows the success of using digital pocketbooks seen from the validation results of material experts and media experts as well as student response questionnaires. The results of the validation of material experts and media experts of researchers with previous studies both stated that the learning media were very feasible to use and the results of student responses both stated that they were very interesting or feasible. The development of this learning media has its own novelty from previous research, namely: The digital pocket book has used the STEM approach focuses on knowing students' mathematical communication skills in the learning process. This digital pocket book also features an interesting application form because in this digital pocket book application, quizzes and interactive learning videos are given which can help students better understand the material and students do not feel bored with learning math

CONCLUSION

The conclusion of the development results in this study include producing learning media in the form of STEM-based digital pocket book on SPLDV material. This learning media was

developed with ADDIE development procedures which include the stages of analysis, design, development and evaluation. The research results indicate that the developed learning media are highly feasible and very interesting for use in mathematics learning, particularly on SPLDV material. The global COVID-19 pandemic prevented this research from reaching the implementation stage. Thus, the effectiveness test of the STEM-based digital pocketbook could not be conducted.

REFERENCES

Ahmad, A., Adi, S., & Gayatri, R. W. (2017). Pengembangan Buku Saku Sebagai Media Promosi Kesehatan Tentang Cacingan yang Ditularkan Melalui Tanah Pada Siswa Kelas IV SDN 01 Kromengan Kabupaten Malang. *Preventia: The Indonesian Journal of Public Health*, *2*(1), 25–36.

Ambarwati, T. (2017). *Pengembangan Buku Saku Digital Menggunakan Model Pembelajaran Problem Solving Pada Materi Himpunan Siswa Kelas VII* (PhD Thesis). UIN Raden Intan Lampung.

Asiah, N. (2016). Paradigma Kontemporer Sistem Pembelajaran Pendidikan Keguruan Madrasah Ibtidaiyah (PGMI). *TERAMPIL: Jurnal Pendidikan Dan Pembelajaran Dasar*, *3*(2), 43–63.

Astuti, I. A. D., Dasmo, D., & Sumarni, R. A. (2018). Pengembangan media pembelajaran berbasis android dengan menggunakan aplikasi Appypie di SMK Bina Mandiri Depok. *Jurnal Pengabdian Kepada Masyarakat*, *24*(2), 695–701.

Diantari, A. (2019). Anisah Diantari, "Pengembangan Media Pembelajaran Online App Builder "Appypie" Pada Pemasaran Online Menggunakan Media Sosial Kelas XI BDP Di SMKN 4 Surabaya. *Jurnal Pendidikan Tata Niaga (JPTN)*, *Vol. 7*(No. 2), h. 461.

Ekawati, T., Anggoro, B. S., & Komarudin, K. (2019). Pengembangan Modul Pembelajaran Matematika Pada Materi Statistika Terintegrasi Nilai-Nilai Keislaman. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, *8*(1), 184–192.

Fajar, R. (2019). *Pengembangan Buku Saku Digital Materi Bangun Datar* (PhD Thesis). UIN Raden Intan Lampung.

Festiawan, R., & Arovah, N. I. (2020). Pengembangan "Buku Saku Pintar Gizi" Untuk Siswa SMP: Alternatif Media Pembelajaran untuk Meningkatkan Pengetahuan Gizi Olahraga. *Physical Activity Journal*, *1*(2), 188–201.

Fitri, H., Izzatin, M., & Ferryansyah, F. (2019). Pengembangan buku saku berbasis kearifan lokal sebagai sumber belajar pada materi bilangan. *Mathematic Education and Aplication Journal (META)*, *1*(1), 8–18.

Hafidz, R. A., Sumardi, K., & Komaro, M. (2019). Desain dan pembuatan media pembelajaran mobile learning pada mata pelajaran sistem dan instalasi tata udara. *Journal of Mechanical Engineering Education*, *6*(1), 71–79.

Hake, R. R. (2002). Relationship of individual student normalized learning gains in mechanics with gender, high-school physics, and pretest scores on mathematics and spatial visualization. *Physics Education Research Conference*, *8*, 1–14.

Hartanto, R. V. P., Triyanto, T., Yuliandari, E., & Ariana, Y. (2020). Civic Literasi Bijak Dalam Bermedia Sosial Bagi Ibu-Ibu PKK Kecamatan Banjarsari Kota Surakarta. *Cendekia: Jurnal Pengabdian Masyarakat*, *2*(1), 16–23.

Komarudin, K., Thahir, A., & Sholekan, S. (2019). Bahan Ajar Berbasis Mathematical Comic: Dampak Terhadap Peningkatan Pemahaman Matematis Peserta Didik. *Jurnal Pendidikan Matematika RAFA*, *5*(2), 98–110.

Latif, M. A. (2016). Implementasi Website Sekolah SMA PGRI Takokak. *SANTIKA (Jurnal Ilmiah Sains Dan Teknologi)*, *6*(1), 465–468.

Mardiah, S., & Rinaldi, A. (2018). Pengembangan Modul Pembelajaran Matematika Berbasis Etnomatematika Menggunakan Metode Inkuiri. *Desimal: Jurnal Matematika*, *1*(2), 119–126.

Maslaha, A., & Suryani, Y. J. (2018). Urgensi Iptek dalam Pengembangan Pendidikan Islam. *Tarbiyah Wa Ta'lim: Jurnal Penelitian Pendidikan Dan Pembelajaran*, *5*(2), 37–45.

Nadeak, B., & Naibaho, L. (2019). Investigating the effect of learning multimedia and thinking style preference on learning achievement on anatomy at Universitas Kristen Indonesia. *Journal of Physics: Conference Series*, *1387*(1), 012116. IOP Publishing.

Nasution, T. (2017). Konsep dasar pendidikan kewarganegaraan dalam membangun karakter siswa. *Ijtimaiyah: Jurnal Pendidikan Dan Ilmu Sosial*, *1*(2).

Nurmala, R., Izzatin, M., & Mucti, A. (2019). Desain pengembangan buku saku digital matematika smp berbasis android sebagai media pembelajaran dalam meningkatkan minat belajar siswa. *Edukasia: Jurnal Pendidikan*, *6*(2).

Pramika, D., & Widalismana, M. (2018). Devi Pramika dan Merlyn Widalismana, "Buku Saku Sebagai Media Pembelajaran Matematika Ekonomi Di Program Studi Pendidikan Akuntasi FKIP Universitas PGRI Palembang. *PROMOSI: Jurnal Program Studi Pendidikan Ekonomi*, *Vol. 6*(No. 2), h. 2.

Putri, Y. F., & Sumbawati, M. S. (2017). Pengembangan Aplikasi Buku Saku Berbasis Android Sebagai Media Pembelajaran Hukum Kesehatan di Akademi Farmasi Surabaya. *Jurnal IT-EDU*, *2*(2), 88–94.

Rihandoko, A. (2018). Pengembangan Media Mobile Learning Appypie Android Berbasis Pemahaman Konsep Peserta Didik Kelas Xi Pada Mata Pelajaran Biologi Di Tingkat Sma/Ma. *Skripsi Program Studi Pendidikan Biologi Universitas Islam Negeri Raden Intan, Lampung*.

Rodiawati, H., & Komarudin, K. (2018). Pengembangan e-learning melalui modul interaktif berbasis learning content development system. *Jurnal Tatsqif*, *16*(2), 172–185.

Rusmaini, R. (2017). Manajemen Pendidikan Karakter di Lembaga Pendidikan Islam. *El-Idare: Jurnal Manajemen Pendidikan Islam*, *3*(1), 132–147.

Saputra, N. E., & Ekawati, Y. N. (2018). Praktikalitas Buku Saku Digital (digital book pocket) APE Tradisonal. *Prosiding Seminar Nasional Psikologi Unissula*.

Saripudin, E., Sari, I. J., & Mukhtar, M. (2018). Using Macro Flash Animation Media on Motion Material to Improve Learning Achievement for Learning Science in Junior High School. *Jurnal Penelitian Dan Pembelajaran IPA*, *4*(1), 68–75.

Septina, N., Farida, F., & Komarudin, K. (2018). Pengembangan lembar kerja siswa dengan pendekatan saintifik berbasis kemampuan pemecahan masalah. *Jurnal Tatsqif*, *16*(2), 160–171.

Setyono, Y. A., Karmin, S., & Wahyuningsih, D. (2013). *Pengembangan Media Pembelajaran Fisika Berupa Buletin Dalam Bentuk Buku Saku Untuk Pembelajaran Fisikakelas VIII Materi Gaya Ditinjau Dari Minat Baca Siswa*. Sebelas Maret University.

Supriadi, N., & Damayanti, R. (2016). Analisis Kemampuan Komunikasi Matematis Siswa Lamban Belajar dalam Menyelesaikan Soal Bangun Datar. *Al-Jabar: Jurnal Pendidikan Matematika*, *Vol. 7*(No. 1), h. 1-9.

Tegeh, I. M., & Kirna, I. M. (2013). Pengembangan Bahan ajar metode penelitian pendidikan dengan addie model. *Jurnal Ika*, *11*(1).

Wibawa, S. (2017). Tridharma Perguruan Tinggi (Pendidikan Dan Pengabdian Kepada Masyarakat). *Disampaikan Dalam Rapat Perencanaan Pengawasan Proses Bisnis Perguruan Tinggi Negeri. Yogyakarta*, *29*, 01–15.

Yahya, M. S. (2006). Strategi Pendidikan Islam Menghadapi Kemajuan Iptek. *Insania: Jurnal Pemikiran Alternatif Kependidikan*, *11*(1), 63–75.

Yaqin, A. (2016). Pengembangan buku saku digital berbasis android sebagai pendukung bahan ajar pada materi pph pasal 21. *Jurnal Pendidikan Akuntansi (JPAK)*, *5*(1).