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DEVELOPMENT OF E-MODULE BASED ON TPACK (Technological Pedagogical Content Knowledge) ON PARABOLIC MOTION MATERIAL FOR GRADE X SMA/MA

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Abstract

Teaching materials are supporting factors used to achieve the objectives of the learning process. The facts obtained in the field are that the teaching materials used by teachers and students are inadequate, especially in the parabolic motion material, the absence of learning media used to help students understand parabolic motion is not just a concept, the lack of teaching materials and learning media causes the learning process to occur only from one direction. So that accompanying teaching materials are needed other than those provided by the school. This study aims to determine (1) the design of the E-Module based on TPACK (Technological Pedagogical Content Knowledge) on the Parabolic Motion Material, and (2) the feasibility of the E-Module based on TPACK (Technological Pedagogical Content Knowledge) on the Parabolic Motion Material with the help of Flip PDF Professional. The method used in this study is R&D with the modelAlessi and Trollip.This modelconsists of 3 stages, namely Planning, Design, and Development. Using an instrument in the form of a validation sheet of material experts and media experts. the results of validation by material experts show that the developed E-Module is very feasible to use with an average score of 95.72% and based on the results of validation by media experts, an average score of 89.50% was obtained with very feasible criteria. Thus, it can be concluded that the TPACK-Based E-Module of Parabolic Motion Material is very feasible to use in the learning process.

Keywords:*E-Learning Module, TPACK, Flip PDF Professional, Parabolic Motion.*

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Introduction

The learning and teaching process have a strong and inseparable involvement. Learning is an activity carried out by students consciously and intentionally. This activity refers to the activeness of students in carrying out mental/physical aspects that can cause changes towards the better (Aprida Pane and Muhammad Darwis Dasopang, 2017). Learning activities can also be interpreted as the interaction of an individual with an environment. Through the surrounding environment, students can also gain new knowledge or experiences (Aprida Pane and Muhammad Darwis Dasopang, 2017). While learning is the process of regulating, organizing the environment around students to encourage students to carry out the learning process.

In the teaching and learning process, both teachers and students need teaching materials to help students understand the material and teachers to deliver or explain the learning material. Based on the Ministry of National Education, "Teaching materials are information, tools, and texts needed by an educator as a learning implementation plan" (Dewi Yustika Sari, 2017). Based on the quote above, it can be concluded that teaching materials are teacher guidelines for implementing learning, the learning materials in question can be printed or non-printed teaching materials.

The preparation of teaching materials is arranged according to the needs of teachers and students in the learning process used to advance the quality of education. Teaching materials are guidelines for teachers and students, with the availability of teaching materials, educators play a greater role as facilitators and students who are more active in the learning process. The design of teaching materials can be used as a distance learning process or face-to-face directly between educators/teachers and students is a characteristic of a teaching system (instructional). During the Covid-19 pandemic, learning is now taking place online, not face-to-face, therefore good teaching materials are designed so that they can be used for learning that is carried out face-to-face or online.

E-Modules are electronic teaching materials that students can access online during learning. E-Modules not only have benefits and advantages for students but are also useful for teachers, especially during the current Covid-19 pandemic. Because physics is not only memorizing theories and concepts, physics learning also requires practicums so that learning does not only use lecture methods but students also conduct experiments/direct

observations and find facts based on analysis of learning videos or direct discoveries in the field through online practicums. The components contained in this electronic module are teaching materials, audio visuals, virtual laboratories and others that can help the learning process, with this E-Modules teachers not only provide teaching materials to students and ask parents to come to school to pick up teaching materials along with student assignments during online learning. With this E-Modules also makes it easier for teachers when teaching so that teachers only act as facilitators and students play a more active role in learning and can help students think more creatively.

The progress of education in the modern era, namely in the 21st century, requires educators/teachers to have 21st century skills that instill communication and work abilities. the same and the use of information from technology in the implementation of learning. Education that was developed in the 21st century does not It is enough to just have knowledge about the concepts and materials being taught and how to teach, but educators must also have knowledge about developments technology and its use in the learning process (Imam Fitri Rahmadi, 2019). Designing the learning process by integrating ICT (Information and Communication Technology) makes a significant contribution to the level of practice pedagogical to students. Teachers are required to have IT literacy skills in the science learning process using various methods and learning approaches. The success of 21st century learning involves understanding concepts, how teachers teach and the use of information technology in a synergistic. In this case, tpack is believed to be suitable to be applied to the learning process in the 21st century, tpack can help increase creativity and activeness of students in the learning process.

Technological Pedagogical Content Knowledge(TPACK) is the science of using appropriate technology media in the application of appropriate pedagogy to teach and explain a well-discussed learning concept that must be mastered by educators (Abdul Quddus, 2019). TPACK in its current development has become a framework that can be used to understand and describe knowledge. teachers in integrating technology into learning (Unay Nurmansyah, Setiana, 2020). TPACK consists of 3 types of basic combinations and blends, namely Technological Knowledge called (TK), Pedagogical Knowledge called (PK), and Content Knowledge called (CK), then from the combination of the 3 basic knowledge produces 4 new knowledge, including Pedagogical Content Knowledge (PCK),

Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) (IGST A Wulandari, 2021).

One of the applications that can be used to develop or design an E-Module is flip pdf professional. Flip pdf professional is an application that can help in creating ebooks or flipbooks that are equipped with various features to help the page editing process ((2019). In this professional flip pdf, it does not only contain text, but it can also be added with learning videos, images, audio, animations, and links that can support the learning process, so that it can be an interesting learning media that is not boring or monotonous ((Trisya Widiastutik, 2021).

Based on direct observation or observation conducted on class X students at SMA Negeri 5 Banda Aceh, several results were obtained. The delivery of material taught by teachers is still focused on the blackboard media due to the limited learning books and the contents of the guide books owned by teachers are too short so that the learning material delivered is difficult for students to understand, students do not have the latest guide books according to the 2013 curriculum, the guide books used by students, especially in class X odd semesters, do not contain parabolic motion learning materials because in the previous KD the parabolic motion material was located in the even semester, while in the latest KD it is located in KD 3.5 odd semester, a small part of the latest books used by students already contain material on parabolic motion, but the contents of the book are too short and only the essence is conveyed. Limited teaching materials can affect student learning outcomes so that they have an impact on unsatisfactory student learning outcomes. Therefore, efforts that can be used in parabolic motion learning are by using E-Modules which are expected to make it easier for students to understand learning materials both face-to-face and online.

Based on the description above, and the results of the initial study/needs analysis in the form of a questionnaire that has been conducted at SMA Negeri 5 Banda Aceh, it can be concluded that the use of teaching materials is needed to support learning activities, especially on parabolic motion material, so that the objectives of a learning process are achieved. With the use of modules, students do not only depend on textbooks provided by the school.

METHOD

The type of research used is research and development (R&D). Research and development is different from educational research, this is because the purpose of research and development itself is to produce a product through field trials and then improve/revise it until it reaches the feasibility stage of the product so that it can be used in the field ((Yudi Hari Rayanto, Sugianti, 2020). In development research, there are various types of research models that can be used, but the one that the researcher uses is the Alessi & Trollip model. There are 3 steps in the development research procedure proposed by Allessi & Trollip as can be seen in the image below.

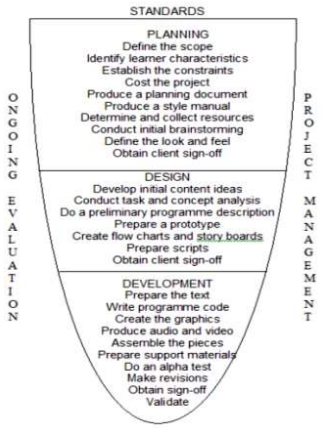

Figure 3.1 Allessi & Trollip Development Design Model.
(Source:Alessi, SM, & Trollip, SR (2001)

The steps taken using the Allessi & Trollip research model can be explained as follows:

1) Planning

At this planning stage, before the researcher determines the objectives and direction of the product to be developed, the researcher must find out what problems will be obstacles in future product development.

a. Define the scope of the study

At this stage, the researcher distributed a questionnaire in the form of a needs analysis to determine the scope of the study in this study. The questionnaire distributed contained 5 learning materials, especially in the odd semester, selected by teachers and students to determine the level of difficulty of which material was considered difficult by

students. That way, the researcher can determine the scope of the study in the form of what material will be developed by the researcher.

b. Identify learner characteristics

In this step, the researcher conducted observations and also direct interviews in the field, this process was carried out precisely at SMAN 5 Banda Aceh, at the observation stage the researcher went directly into the classroom to see the learning and teaching process that was taking place, then the researcher interviewed the teacher and also the students. This step was carried out with the aim of finding out the characteristics of the students, which students are the target users of the products developed in this study.

c. Determine and collect supporting resources (Determine and collect resources)

In this step, researchers collect learning resources used for the product development process, such as learning materials, learning books, learning videos, and applications needed in the development stage.

2) Design

At the design stage, this stage itself is related to development ideas.The initial content begins with compiling the instruments to be developed in the E-Module. Furthermore, the design stage is carried out by determining the components needed in developing the E-Module. Furthermore, the author will collect references used in combining and compiling the material in the E-Module.

a. Develop initial content ideas

This stage is the stage of developing initial ideas on the material being developed and can help other people or users to learn it more easily. At this stage, what the researcher does is how to create a product that is more interesting to be used by students in order to achieve the goals of the desired learning material and students do not feel bored studying it. The researcher looks at the learning achievements and final abilities that are planned so that they obtain the main topics that will be developed in the teaching materials later. At this stage, the researcher also compiles the initial concept of developing teaching materials that can also be used as learning media, namely including layout, color types, and resolution, RPP, LKPD.

b. Create flowcharts and storyboards (Create flowcharts and storyboards)

The researcher created a flowchart that describes each stage that is passed in making the E-Module, the flowchart that is made describes how the researcher can develop the E-Module in the future according to the stages that have been passed previously. In addition to the flowchart that contains a series of how the researcher can develop the desired product, the researcher also created a flowchart of the E-Module that will be developed in the future.

3) Development

At this development stage, it is the implementation process of the design stages carried out previously.Development of E-Modules based on TPACK (Technological Pedagogical Content Knowledge) which is used as a companion to teaching materials provided by the school. At this stage, the development of E-Modules is carried out according to the design. After that, the E-Modules that have been developed will be validated by expert lecturers as validators. This stage refers to the entire process of production, improvement, and validation.

a. Assemble the pieces

At the development stage, researchers need some software to make the product into a complete E-Module. All parts that have been designed in the previous stage such as learning material text, images, learning videos, and links that support the learning process are combined into one, then made into a pdf form and then produced into a program in this study, namely into a professional flip pdf application to become an electronic teaching material.

b. Alpha trial (do an alpha test)

Researchers conducted an alpha trial conducted by 3 material experts and 3 media experts, where the assessment from the media experts covered the appearance and programming aspects, while the assessment from the material experts themselves covered the aspects of the appropriateness of the material content, presentation aspects and also linguistic aspects.

c. validation (validate)

This step is done to determine the feasibility of the product that has been developed, this step the researcher does by providing a media validation sheet to the validator to determine the feasibility of the media used, then a material validation sheet to the validator to determine the feasibility of the content of the material developed. The validation sheet given by the researcher to the validator contains questions that are in accordance with the product being developed which can determine the feasibility of the product being developed.

The research subjects in this study itself consisted of 6 validators, namely 3 media validators who were 2 lecturers in information technology and 1 lecturer in physics education at the Faculty of Tarbiyah and Teacher Training, Uin Ar-Raniry, and 3 material validators who were lecturers in education at the Faculty of Tarbiyah and Teacher Training, Uin Ar-Raniry.

The data collection instruments used are in the form of media validation sheets and materials. The data analysis technique used in this study is quantitative descriptive.The data obtained from the results of the media validation test and learning materials also have an average value and also a maximum value which will be analyzed using the following equation:

$$\overline{X} = \frac{\sum X}{N}$$

Then the average score obtained is converted into a value with criteria to determine the quality of the feasibility of the developed learning E-Module, where the initial score obtained from the development results will then be converted into qualitative data using the following percentage formula:

$$Persentase\ kelayakan = \frac{Rata - rata\ keseluruhan\ aspek}{Skol\ penilaian\ tertinggi} \times 100\%$$

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Table 3.4 Modified Product Eligibility Criteria ((2019)

Criteria	Percentage	Qualification
SB	$81{,}26\% < \times \leq 100\%$	Very Worth It
B	$62{,}51\% < \times \leq 81{,}25\%$	Worthy
KB	$43{,}75\% < \times \leq 62{,}50\%$	Less Worthy
SK	$25\% < \times \leq 43{,}75\%$	Not feasible

3. Results and Discussion

The results obtained from the research and development conducted by the researcher are in the form of an E-Module Based on TPACK (Technological Pedagogical Content Knowledge) on Parabolic Motion Material, which aims to make students better understand physics subjects, especially on parabolic motion material, not only in the form of material, but students can also do practical work and understand how to apply parabolic motion in everyday life.

1) Planning Stage

This stage is the initial step to start a research using the Alessi and Trollip model.

a) Define the scope of the study

This stage includes the process of compiling a needs analysis. Researchers can draw conclusions based on the needs analysis questionnaire that has been distributed to students and teachers. Researchers obtained the same results where the material that was considered difficult to learn by students was vectors and parabolic motion.

b) Identify learner characteristics

Based on the results of initial observations conducted at SMAN 5 Banda Aceh, in this case, it began with the assumption that students had difficulty in understanding the concept of the material being taught, coupled with the lack of teaching materials given to students, then based on the results of observations and interviews,

researchers also found that there was a lack of teaching materials, then the learning process that took place was still monotonous, namely the material was delivered by the teacher while students were only asked to listen and note down concepts related to the material, the lack of motivation and interest in learning students who were influenced by the Covid-19 pandemic which resulted in the teaching and learning process having to be carried out online using gadgets, therefore when the learning process returned to normal, most students still used gadgets and did not pay attention to the learning process that was taking place.

Then the researcher also realized that there were differences in students' learning motivation, understanding, learning styles, and abilities in the learning process.

c) Determine and collect supporting resources (Determine and collect resources)

The researcher collected related sources for the development of TPACK-based E-Modules later, the sources that the researcher collected were related to 8 Physics books for grade X SMA odd semesters, especially those containing parabolic motion material, the researcher also collected learning videos from YouTube that were suitable for product development, images, animations, and applications that will be used for product development, namely Microsoft Word, Flip PDF Professional, Phet Simulation, and Google Form.

2) Design Stage

At this stage, the researcher designed the design for making an E-Module based on TPACK.

a) Develop initial content ideas

In this step, the researcher found that the topic or material to be developed in the product was "PARABOLA MOTION" then the researcher developed a learning plan (RPP), learning materials, and student worksheets (LKPD), in addition to developing this product the researcher used the help of several applications used for the development of E-Modules, namely Microsoft Word which is used to prepare a plan for the development of E-Modules, materials contained in the E-Modules, student worksheets, and E-Modules designs, then Google Form to create student worksheets, phet simulation to conduct online practicums, YouTube to display learning videos that support learning materials,

and Flip PDF Professional which is used to combine all of these components into an E-Module.

b) Create flowcharts and storyboards (Create flowcharts and storyboard)

The flowchart developed by the researcher in this study is based on several stages that have been carried out in the previous stage and based on the problems and solutions that have been obtained, in addition to the flowchart that shows how researchers can develop products, researchers also create a flowchart for future product development to make it easier for researchers to develop products later according to the series that has been arranged in the flowchart.

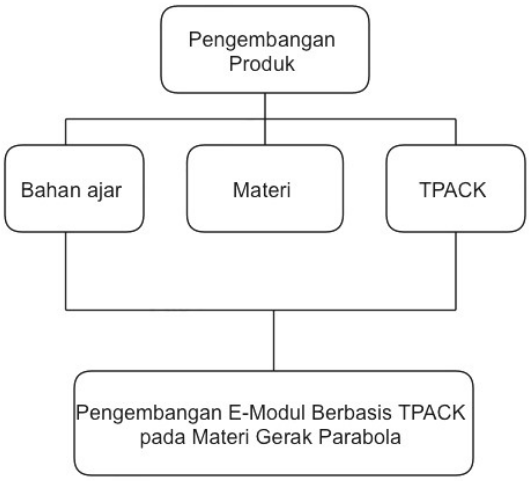

Figure 4.1 Flowchart of the product to be produced.

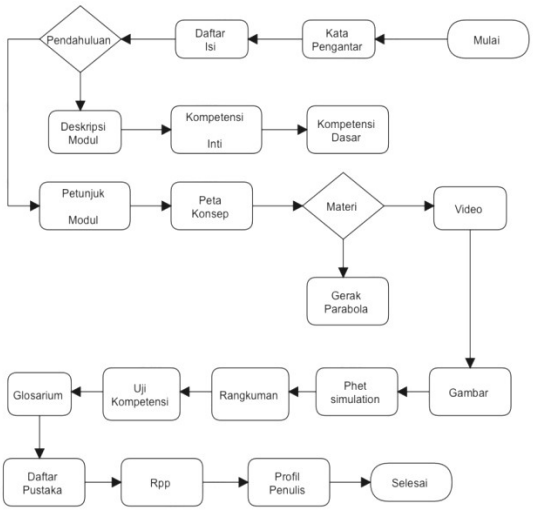

Figure 4.2E-Module development flowchart

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3) Development Stage

a) Assemble the pieces

After the design stage, then proceed to the development stage. This section is the final process in making TPACK-based E-Modules using the Flip PDF Professional application, which functions to combine components in this case learning materials, learning videos, virtual lab phet simulations, learning implementation plans (RPP) and E-LKPD.

b) Alpha trial (do an alpha test)

Researchers conducted an alpha trial conducted by 3 material experts and also 3 media experts, where the assessment of the media experts covered the appearance and programming aspects, while the assessment of the material experts themselves covered the aspects of the feasibility of the material content, presentation aspects and also linguistic aspects, for the alpha trial of the material in this study was conducted by 3 lecturers of physics education Uin Ar-Raniry, and for the alpha media trial was conducted by 1 lecturer of physics education Uin Ar-Raniry and 2 lecturers of informatics engineering education Uin Ar-Raniry.

c) validation (validate)

The feasibility or quality of the TPACK-based E-Module product developed can be seen from the validation results. In this study, the product developed was validated by 3 media experts and 3 material experts as validators.

1. The Feasibility of TPACK (Technological Pedagogical Content Knowledge) Based E-Modules on Parabolic Motion Material by Media Experts

Each validator provides an assessment according to the statement points contained in the validation sheet, namely by giving a check mark in the column or row that is considered appropriate and feasible for the E-Module. The results obtained based on the validation data from the TPACK-Based E-Module on the Parabolic Motion Material can be presented in the following table:

Table 4.1 Validation Result Data by Media Experts

Aspek Penilaian	Indikator Penilaian	Validator 1	2	3	Skor	∑Per Aspek	Rata-Rata	Persentase Kelayakan	Kriteria
Tampilan	1	4	4	4	12	150	3.57	89%	Sangat Layak
	2	3	4	4	11				
	3	3	4	3	10				
	4	3	4	4	11				
	5	3	4	4	11				
	6	3	4	4	11				
	7	3	4	3	10				
	8	3	4	4	11				
	9	3	4	4	11				
	10	3	3	4	10				
	11	3	3	4	10				
	12	3	3	4	10				
	13	3	4	4	11				
	14	3	4	4	11				
Pemrograman	1	3	4	3	10	33	3.6	90%	Sangat Layak
	2	4	4	4	12				
	3	4	4	3	11				
Jumlah Skor		54	65	67	183	183	3.58	89.50%	Sangat Layak
Jumlah Skor									

Based on the data results in the table above obtained during validation by media experts, the percentage of feasibility in the display aspect was obtained, namely (89%) with a very feasible category. Then in the programming aspect, the percentage of assessment was obtained of (90%) with a very feasible category. While for the overall percentage obtained, it was (89.50%). Thus, the overall assessment of the TPACK-based E-Module learning media using flip pdf professional based on the results of the media expert validation is included in the category of very feasible for use.

2. The Feasibility of E-Modules Based on TPACK (Technological Pedagogical Content Knowledge) on Parabolic Motion Material by Material Experts

Each validator provides an assessment according to the statement points contained in the validation sheet, namely by providing a check mark in the column or row that is considered appropriate and feasible for the E-Module. The results obtained based on the validation data of the TPACK-Based E-Module on the Parabolic Motion Material can be presented in the following table.

Table 4.2 Validation Result Data by Material Experts

Aspek Penilaian	Indikator Penilaian	Validator			Skor	∑Per Aspek	Rata-Rata	Persentase Kelayakan	Kriteria
		1	2	3					
Kelayakan Isi	1	4	4	4	20	108	2.88	72.00%	Layak
	2	4	3	4	11				
	3	4	4	4	12				
	4	3	4	4	11				
	5	3	3	4	10				
	6	4	3	4	11				
	7	4	3	4	11				
	8	3	4	4	11				
	9	3	4	4	11				
Kelayakan Penyajian	1	4	3	4	11	45	3.75	93.75%	Sangat Layak
	2	4	4	4	12				
	3	4	4	4	12				
	4	3	3	4	10				
Kebahasaan	1	4	3	4	11	77	3.66	91.75%	Sangat Layak
	2	3	4	4	11				
	3	3	4	4	11				
	4	4	4	4	12				
	5	3	4	4	11				
	6	3	3	4	10				
	7	3	4	4	11				
Jumlah Skor		70	72	80	230	230	3.83	95.75%	Sangat Layak
Jumlah Skor									

From the data from the validation results of the material experts, the percentage of eligibility in the aspect of the eligibility of the E-Module material content was obtained by (72.00%) with a feasible category. While in the aspect of the presentation eligibility obtained a percentage of (93.75%) which is included in the very feasible category. Furthermore, in the linguistic aspect, a percentage of (91.75%) was obtained which is included in the very feasible category. Then the overall percentage results from the validation results obtained a percentage of (95.75%) which means that the entire TPACK-based E-Module on the parabolic motion material from the material experts is included in the very feasible category.

CONCLUSION

Based on the development resultsE-Module Based on TPACK (Technological Pedagogical Content Knowledge) on Parabolic Motion Material for Class X for SMA/MA, it is concluded that:

The design of electronic teaching materials based on TPACK (Technological Pedagogical Content Knowledge) on the Parabolic Motion Material was developed in three stages, namely the planning stage, the design stage, and the development stage, which then produced a product in the form of an E-Module based on TPACK on the parabolic motion material.

The feasibility of the resulting product, namely the E-Module based on TPACK (Technological Pedagogical Content Knowledge) on the Parabolic Motion Material, received

an assessment from each validator, namely, the average percentage obtained from the results of the validation of learning media by the validator was 89.50% which was included in the very feasible category, and for the average percentage obtained from the results of the validation of the material by several validators, namely 95.75% and included in the very feasible category for use.

BIBLIOGRAPHY

Abdul Quddus. 2019. "Implementation of Technological Pedagogical Content Knowledge (TPACK) in the PAI Teacher Training Process (PPG) LPTK Uin Mataram". Tatsqif Journal (journal of education and thought). Vol. 17. No. 2. p. 216.

Alessi, S. M., & Trollip, S. R. (2001). Multimedia for learning: methods and development (3rd Edition). Boston: Allyn and Bacon.

Aprida Pane and Muhammad Darwis Dasopang. 2017. "Learning and Learning". Journal of Islamic Studies. Vol. 3. No. 2 . p. 335-336.

Dewi Yustika Sari. 2017. "Development of DEPDIKNAS Teaching Materials (2)". Accessed on October 18, 2021 from the site:https://id.scribd.com/presentation/356126880/Pemembangan-Bahan-Ajar-DEPDIKNAS-2.

IGST AA Wulandari. 2021. "Training and Mentoring in Preparing Learning Devices Using the TPACK Approach". Journal of Elementary Education, FIP Uin Diksha. ISBN 978-623-7482-72-7. p. 455.

Rara Seruni, Siti Munawarah, Fera Kurniadewi, Muktiningsih Nurjayadi. 2019. "Development of Biochemistry Electronic Module (E-Module) on Lipid Metabolism Material Using Flip Pdf Professional". Jtk: Jurnal Tadris Kimiya, Vol. 4. No. 1. p. 50.

Rhesta Ayu Oktaviara, Triesninda Pahlevi. 2019. "Development of E-Module Assisted by Kvisoft Flipbook Maker Based on Scientific Approach on Material Implementing Operation of Word Processing Application for Class X OTKP 3 SMKN 2 Blitar". Journal of Office Administration Education. Vol. 7. No. 3. p. 63.

Trisya Widiastutik. 2021. "Development of Indonesian Language E-Module for Grade XII with Flip Pdf Professional as an Alternative Learning in the Midst of the Covid 19 Pandemic". Journal of Religious Education and Training, Vol. 15, No. 1. p. 37.

Unay Nurmansyah, Setiana. 2020. "Efforts to Improve Students' Learning Outcomes on Arithmetic Sequences and Series Material Through the Scientific TPACK Approach". My Amount (Journal of Scientific Mathematics). Vol. 6. No. 1,200.

Yudi Hari Rayanto, Sugianti. 2020. "Addie and R2D2 Model Development Research: Theory and Practice". Pasuruan: Academic and Research Institute. p. 18.