

Development of Mathematics E-Modules Through the Professional Flip PDF Application Assisted React Strategy to Improve Problem Solving Ability of Vocational Middle School Students Concentration of Accounting Expertise

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Abstract

This study aims to describe the process and results of developing E-teaching modules in the independent learning curriculum through the REACT Strategy (Relating, experiencing, applying, cooperating, and transferring) with the help of professional Flip PDF, for students in Phase E of Accounting Expertise Concentration. In the structure of the independent learning curriculum for Vocational High Schools, there are 2 groups of subjects, namely general subjects (A) and groups of vocational subjects (B). needed by the world of work, mastering science and technology, arts and culture. E-module development using the ADDIE model with the stages of development: Analysis, Design, Development, Implementation, and Evaluation. The resulting product is a mathematics e-module with the REACT Strategy assisted by a professional flip pdf application that can be accessed by students using Android. Based on the results of utilization in the field, the resulting E-module can improve the problem-solving ability of students. This e-module with the REACT strategy assisted by flip PDF is feasible to be used as an alternative in mathematics learning, especially to familiarize students with being able to define problems, diagnose problems, formulate alternative strategies, choose alternative strategies and evaluate in mathematics lessons that incorporate technology. Based on the results of 28 students' answers to banking math problems in the e-module, the average score is 61.78 with a percentage score of 77.23% with a high category.

Keywords: E-Modul, Flip PDF professional, REACT strategy, Problem Solving.

A. INTRODUCTION

The explanation in the decision of the minister of education, culture, research, and technology No. 56 of 2022 page 32 regarding the structure of the independent curriculum for the Vocational High School level states that subjects are grouped into 2 main parts: general group (A) and vocational group (B). Mathematics is included in the vocational group (B) which functions to form Vocational High School Students to have competencies according to the needs of industry and the world of work, science, technology, arts and culture. The decision of the minister of education, culture, research, and technology explanation implies that the role of Vocational High School mathematics as part of the subjects in the vocational group is the basis of knowledge about logical thinking which is very much needed by Vocational High School graduates as the basis for mastering the development of modern technology.

The role of mathematics is very dominant, especially in advancing human reasoning and thinking. Mathematics in Vocational High Schools is positioned as a conceptual tool to construct and reconstruct, train, hone and solve problem solving in students' lives, especially the usefulness of mathematics in equipping students to enter the business world, industry and the world of work. The next role of Vocational High School mathematics is to hone analytical skills, think logically, creatively, critically and systematically. This ability is a set of mathematical skills competencies needed in the world of work, making Vocational High School Students have the ability to find and utilize information, manage, formulate and conclude the best solutions to answer the challenges of an era that is full of competitive, always changing and full of uncertainty.

Mathematics trains students to be logical, to reason, through mental activities through systematic thinking lines that lead to the formation of a flow of understanding in the form of facts, concepts, principles, operations, relations, problems, and universal and formal mathematical solutions. The mental process strengthens the disposition of students to understand the benefits and meaning of studying mathematics and the character values implied in mathematics lessons which include self-confidence, broad-minded, creative, tough, diligent, disciplined, independent, patient, rational, accurate, systematic, able to make assessments, have skill and freedom.

Mathematics in the independent learning curriculum is packaged into groups of vocational subjects through the application of the study fields of Numbers, measurement, algebra, data analysis, geometry, probability and calculus. The objectives of mathematics lessons in the independent curriculum are adjusted to the mathematical objectives of the concentration of expertise in accounting expertise concentration by studying mathematics: 1) Students understand, facts, concepts, principles, operations, and mathematical relations, and can apply them to accounting studies in a flexible, efficient, accurate manner, and precise in solving mathematical problems. 2) skilled in reasoning with properties and patterns, mathematical manipulation in generalization, proof, compiling and explaining mathematical statements and ideas at the concentration of accounting expertise, 3) skilled in understanding problems, designing models, completing models, and interpreting solutions in problem solving Mathematics mathematics at concentration of accounting expertise, 4) skillful in communicating ideas and ideas in the form of symbols, diagrams, tables and other media, in order to clarify problem solving, as well as presenting a model solution in mathematical symbols 5) skillful in connecting facts, concepts, operations and mathematical relations in accounting studies, studies across other scientific fields in everyday life. 6) have the character of appreciating the usefulness of mathematics in life with personality indicators: curiosity, high interest in mathematics, focus on learning, creative, patient, independent, open to the possibility of criticism of procedural errors, tough, tenacious and confident in solving math problems in the concentration of accounting expertise.

Characteristics of mathematics subjects in the concentration of accounting skills include: 1) content elements related to the view that mathematics is a subject matter that must be mastered by students, 2) process elements, which are associated with conceptual tools to construct and reconstruct mathematics from mental activities through the flow of thinking who can develop skills in the field of accounting.

To make it easier for students to be skilled in solving problems according to the characteristics of accounting mathematics, learning strategies are needed that are in accordance with their learning philosophy. One strategy that can be used is REACT, which is an extension of contextual learning to construct and reconstruct mathematics according to the objectives and characteristics of mathematics. So that the basis for thinking in the REACT strategy is similar to the basis for thinking in a contextual approach. Dawey (1916) in Sanjaya 2002, argues that the learning process will be productive if students can learn by connecting the knowledge, they have previously with the knowledge to be learned. this is in line with the philosophy of constructivism which views the active interaction of the environment, assimilation and accommodation processes can affect the knowledge of students.

Learning with a constructivist view has three characteristics, namely: 1) Students are active in learning to find their own knowledge, the teacher's role is only to guide and facilitate learning 2) discovery of student information based on the knowledge that has been obtained by previous students, 3) learning activities investigation and discovery oriented. REACT is a contextual learning development with a learning strategy that emphasizes students who discover the concepts they are learning, students collaborate to find and apply concepts in everyday life and transfer the acquired knowledge into new concepts.

REACT strategy is an acronym that contains five main activities Strategies: 1) relating, meaning that the mathematics subject matter to be studied is related to the knowledge possessed by previous students, 2) experiencing, students are actively involved in exploring, discovering from various existing sources about the concept the mathematics they will learn, 3) applying, after finding the appropriate mathematical concepts. Students apply these concepts in solving mathematical problems, 4) cooperating, which describes the process of discovering and applying mathematical concepts through working and studying in small groups, by discussing each other to strengthen one another. with others by finding common solutions to mathematical discoveries, applications and solutions. and 5) transferring, students connect and share the knowledge gained during learning into everyday life or other situations (REACT).

In the digital era, learning activities must be transformed, old methods that do not utilize information technology are no longer relevant for the current generation. Educating Generation Z, whose daily life is so closely related to technology, requires teachers to master technology. Teachers must be able to present existing teaching materials by utilizing technology, especially those used by students on a daily basis, namely mobile phones. For this reason, the teaching module with the REACT strategy that was developed will then be designed into an e-module so that students can use

their phones cell in learning activities. Of course, the material, learning content that is presented in e-mathematical modules can be studied by students anytime anywhere, and not limited to school hours, with the use of this phone cell it also allows students to learn continuously, and teachers can guide Students are not limited by space and time because tutoring can also be done outside school hours by means of students consulting through WhatsApp groups or other platforms.

The teaching module on Compound Interest Exponent material for phase E students, which was developed with the REACT strategy, then by using the flip pdf corporate application, it is hoped that in addition to presenting contextual learning by utilizing technology that is closely related to everyday life, students can also provide cheap and easy mathematics learning accessible to students. flip pdf professional is software for creating E-modules in the form of flipbooks that use various media such as audio, video, and Flash.

Hidayatulloh (2017), states that E-Module is a form of electronic presentation of teaching materials containing learning content that is systematically designed to achieve a certain competency. Ula and Fadila (2018) reveal that the E-Module presented will be more attractive if it is supported by other applications such as Flip PDF Professional, Microsoft Power Point, Photoshop, Corel Draw, and other applications that can display text and images which are then used. as a material in the manufacture of interactive modules. In its use, e-modules can contain learning content in the form of audio, video, text, images, graphics, diagrams, and so on in one application. E-modules can also be accessed by students via android devices or laptops. Simply by installing the e-module reader application, students can read the electronic module at any time, as long as an android device or laptop can read the e-module.

According to Razali in Osman K and Vebrianto R 2013, learning media is a tool needed to strengthen the teaching and learning process. In one study, it was explained that it is better to train science process skills using multimedia E-modules are one of the media that can be used in learning. E-module is a collection of several subject matter published in digital form, which consists of text, images or both and can be read through a computer or other electronic device. Currently the E-module can be displayed in the form of a flip module. One of the E-module maker software in the form of a flip module is Flip PDF Professional.

Based on the description of the background, the formulation of the problem raised in this study is 1) how is the feasibility of e-module teaching materials with the REACT strategy assisted by the professional flip pdf application, to familiarize students' problem solving abilities in mathematics lessons at concentration of accounting expertise 2) How is problem solving ability solving Vocational Middle School students concentrate on Accounting skills after using the e-module with the REACT strategy assisted by a professional flip pdf.

B. METHODS

Development research according to Sugiyono (2016) is a research method used to produce certain products, and test the effectiveness of these products. Development research is longitudinal (in stages and can be in a fairly long period of time), because to be able to produce products, research that is needs analysis is used. Then to test the effectiveness of the product so that it can function well in the community, research is needed to test its effectiveness.

According to Trisiana & Wartoyo (2016), research and development (research & development) is research that aims to develop a model, either in the form of hardware (hardware) or in the form of software (software). Answering the first problem formulation in this study, the e-module developed using the ADDIE development model with the stages of development: Analysis, Design, Development, Implementation, and Evaluation. The resulting product is a mathematics e-module with the REACT Strategy assisted by a professional flip pdf application that can be accessed by students using Android.

The sample in this study was the students in phase E of the concentration of accounting expertise at Nanga Tayap 1 Vocational High School, Ketapang Regency, West Kalimantan Province, totalling 28 students. To assess the feasibility of the resulting product, it was validated by mathematics teachers, productive accounting teachers, mathematics lecturers at the Faculty of Teacher Training and Education, Tanjungpura University.

1. Math E-Module with REACT strategy flip pdf Professional

The e-module referred to in this study is a Vocational High School mathematics learning module in the concentration of accounting skills using the REACT strategy, which was made using professional flip pdf software. According to Maryam et al (2019), Flip Pdf Professional is an application that supports as a learning tool that can assist in the learning process because this application is not only focused on writing but can include motion animation, video, and audio that can make an interesting interactive learning media so that learning is not monotonous. The operation of this software is very easy and can be accessed offline.

In accordance with the acronym, the process of implementing the REACT strategy in learning mathematics, concentrating on accounting skills, follows five steps to form a cycle of activities that is repeated and uninterrupted. The syntax for learning mathematics strategies through REACT is listed in the table below:

REACT Syntax	Activity
<i>Relating</i>	The teacher begins learning mathematics, by presenting contextual problems in the field of accounting that contain new content related to concepts that have been learned by students or knowledge that students have previously

<i>Experiencing</i>	Students carry out experimental activities, or hands on activities to find mathematical concepts to be studied based on contextual problems in the previous cycle, and the teacher helps and directs students to carry out their activities.
<i>Applying</i>	Learners practice applying the mathematical concepts they find and then learn that knowledge in solving accounting math problems
<i>Cooperating</i>	Learners study or work in small groups, discuss and strengthen each other by finding joint solutions to the discovery, application and completion of accounting mathematics
<i>Transferring</i>	Students apply the knowledge they have gained during mathematics learning into new situations or contexts

After the mathematics module has been compiled according to the REACT strategy syntax, the module is then validated. The feasibility of the e-module in this study refers to the standards for assessing teaching materials by BSNP, namely content feasibility, language feasibility, presentation feasibility, and graphic feasibility. Feasibility of content has several indicators, namely containing all learning outcomes, conformity of the material with the Analysis of Learning Objectives, accuracy of the material, supporting learning materials, and up-to-date material. The feasibility of language has several indicators, namely straightforward, communicative, dialogical and interactive, conformity to the level of development of learners, and the use of terms, symbols, or icons as a mathematical language. Feasibility of presentation has several indicators, namely presentation technique, presentation support, learning presentation, and completeness of presentation. The feasibility of the graphic has several indicators, namely the suitability of the module design layout, and the suitability of the module content design layout.

Modules that are in accordance with the standards of the National Professional Certification Agency in terms of appropriateness of content, language, presentation and subsequent graphics using professional flip PDF software are made e-modules in flip module displays that can be accompanied by audio, video, animated images and others. According to Selvia (2018), by using the software, the display of media will be more varied, not only text, images, videos, and audio can also be inserted in this media.

2. Problem Solving Ability

In mathematics, one of the skills needed is problem solving ability or the ability to solve mathematical problems. According to NCTM (2000), problem solving in mathematics is central to finding and linking overall learning plans in mathematics to provide a context for learning and application of mathematical ideas. Students can learn and deepen their knowledge of mathematical concepts by working carefully in solving certain problems that can lead students to other concepts in mathematics (NCTM, 2000).

The ability to solve mathematical problems is the foundation of school mathematics. Without the ability to solve mathematical problems, the usefulness and power of mathematical ideas, knowledge, and skills will be very limited. Students who can develop and perform a solution to solve a mathematical problem demonstrate deeper knowledge and are more useful than performing a calculation (NCTM, 2000).

According to Johnson & Johnson (Tawil & Liliyasi, 2013), there are indicators that characterize that the current e-module contains problem-solving abilities. The indicators are as follows:

- a. Able to define problems, namely formulating problems from certain events that contain conflict issues, so that students understand what problems will be studied. In this case, students must be able to define several problems regarding hot issues that occur in their environment;
- b. Able to diagnose problems, namely determining the causes of problems, as well as analyzing various factors, both factors that can hinder and factors that can support in solving problems. If the first thing to do is identify the problem, then students must be able to investigate or find the cause or reason for the problem so that they can find a solution;
- c. Able to formulate alternative strategies, namely testing every action that has been formulated through class discussion. Overcoming a problem, of course, can do various things according to the level of the problem. The strategies used can also be different so there is a need for other alternative strategies if one strategy cannot successfully overcome a problem;
- d. Able to determine and implement the strategy of choice, namely making decisions about which strategy can be carried out. Decision making is very necessary in solving a problem because it determines the best strategy from several alternative strategies;
- e. Able to carry out evaluations, both process evaluation and result evaluation. Evaluation is carried out in order to correct things that are wrong from process activities and results carried out when solving a problem. So that it will be a reflection for the next to do a better strategy.

Problem solving ability in this study is the ability of students to solve a mathematical problem in accounting, based on the Johnson & Johnson steps seen in the mathematical problem solving ability test. The steps include (1) defining the problem, (2) being able to diagnose the problem, (3) formulating alternative strategies, and (4) determining and implementing the preferred strategy. 5) evaluate.

Next, to answer the second problem formulation, how is the problem-solving ability of students after using the mathematics e-module teaching materials with the REACT strategy assisted by Flip PDF Professional:

- a. Classify samples based on very high, high, medium, and low categories with the following criteria:

No	Category Problem Solving Ability	Score Range
1.	Very high	90% percentage score 100%
2.	Tall	75% percentage score < 90%
3.	Currently	55% percentage score < 75%
4.	Low	40% ≤ percentage score < 55%
5.	Very low	percentage is less than 40%

- b. Giving a score of students' mathematical problem solving abilities, the results of the scoring will be expressed in percentage form, with the following formula:

$$\text{Percentage} = \frac{\text{student scores}}{\text{test maximum score}} \times 100$$

- c. Describe the results of the sample scoring.

C. RESULTS AND DISCUSSION

In general, this study aims to produce products in the form of accounting mathematics e-module teaching materials with the REACT strategy assisted by professional PDF flips, to improve the problem-solving abilities of Vocational High School Students. The research was conducted at the Nanga Tayap 1 Vocational High School which is a Center of Excellence Vocational High School in Ketapang Regency which carries out a concentration of accounting expertise. The steps for developing e-modules with the ADDIE development model are listed in the following table:

ADDIE Syntax	Draft	General Procedure
<i>Analyze</i>	Identification of possible causes of the gap in Mathematics learning in the concentration of accounting expertise	<ol style="list-style-type: none"> 1. Validating gaps in vocational high school mathematics learning activities concentration accounting skills 2. Determine the achievement of teaching objectives and analyze learning objectives that are in accordance with the learning topic 3. Identify the required resources 4. Define potential delivery systems (including cost estimates) Develop a project management plan
<i>Design</i>	Verify the need for appropriate e-modules to address the gap in mathematics learning with appropriate strategies	<ol style="list-style-type: none"> 5. Selecting and using the REACT strategy (relating, Experiencing, applying, cooperating, transferring) in the accounting mathematics module

		6. Make the next module design into an e-module using the Flip pdf professional application
<i>Develop</i>	Design Create and validate accounting math E-modules with appropriate strategies	7. Produce products in the form of modules 8. E-module validation is carried out according to the assessment of BSNP teaching materials including content feasibility, language feasibility, presentation feasibility, and graphic feasibility. 9. Make improvements to the e-module based on the validation results
<i>Implement</i>	Prepare the learning environment and involve students in the application of the resulting e-modules	10. Prepare Students 11. Doing e-module implementation
<i>Evaluate</i>	Assessing product quality and teaching process, both before and after e-module implementation	12. Determine evaluation criteria 13. Choosing an evaluation tool 14. Carry out evaluation

To obtain information about the feasibility of e-module teaching materials, the researcher conducted a validation process with 1) productive accounting teachers, 2) Master of Mathematics lecturers, FKIP Untan 3) stakeholders in the Business World Industry and the World of Work in the accounting and banking fields. more senior in terms of age, experience and knowledge of accounting mathematics. Information from these two informants is very necessary as well as key informants. These two informants are very relevant to the problems that will be questioned and are closely related to the subjects they teach.

The following are the results of interviews obtained from informants related to the feasibility of the accounting mathematics e-module with the REACT strategy assisted by professional flip PDFs to familiarize the problem-solving abilities of students at Nanga Tayap 1 Vocational High School as follows:

1. Feri Faturrahman, Mathematics teacher

The mathematics books used today do not contain problem definitions, problem diagnoses, formulate alternative strategies and evaluations in the accounting field. This e-module already contains five problem solving indicators in mathematics.

2. Darma Setiaita, Productive Accounting teacher

In my opinion, the alternative strategy in solving the problems presented in this e-module can meet stakeholder expectations in the application of mathematics in the banking sector.

3. Ahmad Yani, Lecturer of FKIP UNTAN

In terms of legibility, the concept of the method and product results are feasible to use in learning activities.

The following are the results of interviews with several students regarding the Problem-Solving Ability of Students After Using the Accounting Mathematics E-Module Teaching Materials with the REACT strategy assisted by Flip PDF.

1. DT, AKN Phase E Students

"This module is very good, because today's technology is using sophisticated technology. Technological sophistication must be developed in the world of learning and teaching. With this e-module, teachers and students are not out of date and the teaching and learning process becomes fun. It would be great if it was implemented."

2. MG, AKN Phase E Students

"In my opinion, e-modules are better used for the teaching and learning process because they look attractive and can be accessed anytime when I want to re-learn math material".

3. SHN, AKN Phase E Students

"I think this e-module is good, very unique and hopefully it can be applied in other lessons as well, hopefully this e-book can inspire teachers in other fields of study for e-modules like this".

4. SU, AKN Phase E Students

"In my opinion, the e-module material is good, because it is simple to use. It is enough in one gadget. Students are able to carry books in non-physical form, so they no longer have to carry heavy physical books."

5. EPO, AKN Phase E Students

"Perhaps this kind of learning can be tried during KBM, because you can learn while mastering calculations in banking mathematics."

6. AN, AKN Phase E Students

"The e-module is already very good. Because the material presented is very clear and is accompanied by a learning video link."

7. AK, AKN Phase E Students

"The use of e-modules in learning media is a new thing for me. The new look makes me more enthusiastic about learning. I think it's very creative."

8. TRR, AKN Phase E Students

“In my opinion, the e-module is very good for supporting student learning activities in the digital era. The drawback in my opinion, as a student, I feel that this e-module can be more lively by adding colors, and some gifs can make reading it more enthusiastic. That way we might not get bored easily in understanding and learning with this e-module”.

The following is a table of the results of measuring students' problem-solving abilities:

No	Student Name	score before	Score Percentage	acquisition score	Score Percentage	Problem Solving Ability
1	An	45	56.25%	74	92.50%	Tall
2	Ra	52	65.00%	72	90.00%	Tall
3	Fc	42	52.50%	56	70.00%	Currently
4	Mn	48	60.00%	64	80.00%	Tall
5	DI	46	57.50%	62	77.50%	Tall
6	AP	47	58.75%	63	78.75%	Tall
7	RNH	43	53.75%	60	75.00%	Tall
8	NA	43	53.75%	60	75.00%	Tall
9	AW	40	50.00%	60	75.00%	Tall
10	MK	42	52.50%	60	75.00%	Tall
11	NA	41	51.25%	62	77.50%	Tall
12	AF	48	60.00%	50	62.50%	Currently
13	MRA	47	58.75%	64	80.00%	Tall
14	DT	46	57.50%	64	80.00%	Tall
15	MNG	43	53.75%	55	68.75%	Currently
16	NR	41	51.25%	55	68.75%	Currently
17	AS	46	57.50%	63	78.75%	Tall
18	SU	50	62.50%	60	75.00%	Tall
19	AN	44	55.00%	54	67.50%	Currently
20	IF	53	66.25%	63	78.75%	Tall
21	AK	49	61.25%	67	83.75%	Tall
22	SHN	60	75.00%	67	83.75%	Tall
23	RH	52	65.00%	58	72.50%	Currently
24	MA	48	60.00%	58	72.50%	Currently
25	NA	54	67.50%	64	80.00%	Tall
26	AFD	56	70.00%	66	82.50%	Tall
27	EPO	50	62.50%	60	75.00%	Tall
28	TRR	59	73.75%	69	86.25%	Tall
Total		1335	16.6875	1730	2163%	
Mean		47.67857	0.595982	61.78571	0.7723214	

From the table above, it can be seen that the problem-solving abilities of students after using e-modules are in the medium to high range. This indicates that students who are at a low academic level are getting used to using problem solving skills in solving problems. Based on the answers from students, most of them have started to smoothly solve problems using the steps according to Johnson & Johnson. Only in the fourth step, the students still have difficulties. Very few of them did the activity of re-checking the answers. Most are only satisfied with the answers obtained without being checked for correctness. But this step is good enough considering that the previous students were not used to using the five steps of solving problems from Johnson & Johnson.

D. CONCLUSION

Accounting mathematics E-Module teaching materials with REACT strategy can familiarize students' problem-solving skills at Nanga Tayap 1 Vocational High School deserve to be used as an alternative in learning mathematics, especially to familiarize students with being able to define problems, diagnose problems, formulate alternative strategies, choosing alternative strategies and evaluations in mathematics lessons that incorporate technology.

e-modules with the REACT strategy with five problem-solving indicators according to Johnson & Johnson, can help students determine alternative strategies in solving the problems presented and can meet stakeholder expectations in the application of mathematics in the banking sector. digital Based on the results of 28 students' answers to banking math problems in the e-module the average score is 61.78 with a percentage score of 77.23% in the high category. But there are some weaknesses that need to be fixed so that the design content in the e-module is made more attractive. Thus, it is possible for readers not to get bored easily in understanding and learning with e-modules.

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