

ENTREPRENEUR MATHEMATICS (ENTREMATH): TEACHING MATERIALS IN IMPROVING PROBLEM SOLVING SKILLS

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Abstract

Mathematics in SMK is a general subject that must be understood, in fact many students avoid mathematics, one of the reasons is because the teaching materials have not facilitated the characteristics of students. The purpose of this study is to evaluate the validity, application, and effectiveness of digital entrepreneurship-based mathematics modules in improving students' problem-solving abilities. With students from class XI vocational courses, this research applies the ADDIE paradigm. Data were obtained using Entremath validation questionnaires, student and teacher response questionnaires, and *post-test scores*. The results show that mathematics is entrepreneur-based. Entremath is considered to fall under the very valid criteria. It is declared practical, with 86.9% of students and 96% of teachers belonging to the very practical category, and effectively denoted by a sig value greater than table t. The results of entrepreneurial mathematics research contain qualities that can be used for mathematics education

Keywords: Entrepreneurial character, mathematical problems solving, teaching materials.

Abstrak

Matematika di SMK merupakan mata pelajaran umum yang harus dipahami, nyatanya banyak siswa yang menghindari matematika, salah satu penyebabnya adalah karena bahan ajar yang belum memfasilitasi karakteristik siswa. Tujuan penelitian ini adalah untuk mengevaluasi validitas, penerapan, dan efektivitas modul digital matematika berbasis kewirausahaan dalam meningkatkan kemampuan pemecahan masalah siswa. Dengan peserta didik kelas XI program studi SMK, penelitian ini menerapkan paradigma ADDIE. Data diperoleh dengan menggunakan angket validasi Entremath, angket respon siswa dan guru, serta nilai *post-test*. Hasilnya menunjukkan bahwa modul digital matematika berbasis wirausaha dianggap masuk dalam kriteria yang sangat valid. Dinyatakan praktis, dengan respon positif 86,9% dari siswa dan 96% dari guru termasuk dalam kategori sangat praktis, dan efektif ditunjukkan dengan nilai sig lebih besar dari t tabel. Hasil penelitian matematika kewirausahaan mengandung kualitas yang dapat digunakan untuk pendidikan matematika.

Kata Kunci: Kemampuan pemecahan masalah, modul digital Matematika berbasis kewirausahaan.



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INTRODUCTION

In Indonesia, vocational school students still experience difficulties in solving mathematical problems. The usual thinking process only uses concepts in a structured manner (Aminah et

al., 2022b). Low proficiency in mathematical solving is also common when studying composition functions and inverse functions. There are difficulties experienced by grade XI SMK students in solving the problem of

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composition functions and inverted parts caused by factors such as the inability to compile the given problem-solving steps and lack of skills in operating composition functions and inverse functions. One of the reasons is due to the teacher's teaching method, It has not been able to adapt instructional materials to the needs of pupils, resulting in students' limited ability to solve problems requiring composition and reverse functions. Even though the 2013 curriculum mandates a change from a teaching community to a learning community and from teaching to learning (Rahadi et al., 2024).

Teachers can integrate mathematics learning with entrepreneurship education by innovating learning in the methods, teaching materials and media used. In-progress teaching material svery helpful learning students or readers in understand specific material (Rizki & Linuhung, 2016). Education in entrepreneurship helps students Being responsible is a measure of one's attitude towards carrying out one's responsibilities. Regarding mathematical learning, the teaching of entrepreneurship implies a practical and theoretical education on how to start training with a meaningful phenomenon of learning in which students participate in activities in settings in which they can influence and manage the learning process at a social level (Aminah et al., 2023; Maydiantoro et al., 2021; Yitshaki & Kropp, 2016). Entrepreneurial competence is almost identical to mathematical competence in terms of (1) creativity, (2) the ability to be responsible, (3) courage, (4) the ability to take initiative, (5) tolerance for ambiguity, and (6) the ability to collaborate, the mathematics study program is very suitable to be implemented (Palmer, 2021).

Someone who (Palmer, 2017) Entrepreneurship is often faced with uncertain situations. However, what seems to be agreed in this context is that entrepreneurship is something positive and should be taught about entrepreneurship, not entrepreneurship. The entrepreneurial context here is very well trained in any field; The emphasis is on the character and way of thinking of the entrepreneur, not only on his profitability. But in reality there is no teaching material that facilitates having this attitude of responsibility. Through an electronic module we named Matematika Entrepreneur(Entremaths) is very similar to an e-book.

With the media of understanding, the learning process can surpass the experience of students in learning in the classroom (Ramadhani et al., 2023). By using media, students can get experiences that cannot be obtained when learning in class. For example, students can see objects they can't see in class. Electronic module research shows that electronic modules are the latest media that can increase student enthusiasm for learning. (Sprock et al., 2014). A teacher's intent to create a learning experience that combines affective, psychomotor, and cognitive components can be determined by his or her ability to select concepts, models, media, systems, learning strategies, and indicators of learning questions (Aminah & Wahyuni, 2018, 2019; de Vries et al., 2015; Rossi & Trevisan, 2018; Wahyuni et al., 2020).

The lack of excitement and interest among students to use print modules is the result of a general lack of variety in print modules. Electronic modules have the ability to incorporate other media, including pictures, animation, music, and video, making them suitable for usage as interactive

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media. This is one technique to make modules more interesting for students. The utilization of technology is advantageous for education. One of the learning tools that can be utilized in the study of mathematics is the digital module (Entremath). A digital learning resource called Entremath is accessible content that is (Amalia & Sukestiyarno, 2021; Aminah, Maat, & Sudarsono, 2023; Poultsakis et al., 2021; Vaiopoulou et al., 2021) governed by the capabilities to be achieved on a computer or mobile device (Cahyono et al., 2020).

According to theory and some previous research, learning media can be combined with other fields of knowledge, such as entrepreneurship, and with learning models, one of which is realistic mathematics, to improve students' ability to solve general mathematical problems (Aminah, Mistima Maat, et al., 2023). In parallel with the researcher the program is created with Adobe Flash. Those who teach in computer-based learning will benefit from this effort (Yulando et al., 2019). The above presentation provides an overview reported in this article in the form of research results that discuss the Entremaths module that is produced valid, and the teaching strategies used are realistic and successful in increasing students' capacity to solve mathematical problems.

METHOD

The ADDIE model (analysis, design, development, implementation, and evaluation) was used as the methodology for this investigation, with a combined qualitative and quantitative approach. This method was chosen because the purpose of the study required it, but Entremath preliminary studies were developed using qualitative methods.

Comparatively, quantitative methods evaluate the efficacy, usefulness, and validity of this created Entremath and its knowledge. Posttest-Only Control Group Design is used in this study design. There are two randomly chosen groups (R) in this research design. This design consists of two groups: Treatment (X1) for the first group involved teaching them mathematics using practical mathematical models and supporting them with entrepreneurial-based mathematical entremath. (Sukestiyarno, 2020).

While the others are just ordinary learning carried out by teachers in the form of lectures (X2). While the treatment group (X2) is referred to as the control class, the treatment group (X1) is known as the experimental class.

Participants

This study involved 16 classrooms of grade XI students at the vocational school. Based on sampling using simple random sampling because participants are randomly selected, ignoring population stratification. Two serves as the control class, and class One serves as the experimental class. Experimental classes are given therapy in the form of entrepreneurship-based mathematics teaching. Although Entremaths uses realistic mathematical simulations, the control class is the only one who gets education through lectures, which is the norm for professors. Research class data are presented in Table 1.

Table 1. Class data as a subject

Class	Group	Sum Students
XI TKJ 1	Experiment	36
XI TKJ 2	Control	36
Entire		72

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Technical Analysis and Data Collection

The data in this study is in the form of data obtained from interview sheets, questionnaires, and tests. Interview sheets are used during preliminary studies to discover underlying problems at the research site. Then the questionnaire used is in the form of a questionnaire to study student needs during preliminary studies to find out the requirements and character of students in learning mathematics.

In addition, the validity of entrepreneurship-based mathematics Entremaths was assessed using questionnaires from students and teachers as well as students and teachers. In addition, posttests are used to measure students' ability to solve math problems.

RESULT AND DISCUSSION

The research process following the ADDIE model of this stage is carried out to analyze problems in the field and the needs of Entremath development. Some of what is done at this stage is gap analysis, student needs analysis, material analysis, and learning objectives analysis. Furthermore, the design stage includes the product design process (Entremath), learning tools, and the preparation of research instruments. The entremath developed at this stage is called Draft 1, this development stage is the Entremath validation stage which has been prepared as Draft 1. Experts perform validations.

To validate whether the developed Entremath is valid, validators are given a questionnaire or validation sheet. Two professors and one math teacher serve as validators for the entremath validation process. Furthermore, the validated Entremaths are then upgraded to draft 2 based on validator suggestions.

In addition, at the implementation stage, at this implementation stage, mathematics learning is carried out using entrepreneurship-based mathematics Entremaths, in practical classes with as many as 4 meetings.

Then, using a questionnaire with student and teacher responses, a practicality test was conducted. The last stage is *evaluation*, which is the process carried out to determine the effectiveness of the product. At this stage of evaluation, posttest tests are carried out in experimental classes and control classes. Then after that, the posttest test result data is analyzed.

1. Analysis stage

The findings of this study are in the form of a needs analysis by looking at pandemic conditions for learning needs, reviewing appropriate curricula, especially autonomous learning curricula, and examining the characteristics of prospective teachers. Our analysis findings were used as a guide when modeling pandemic teaching practices (Aminah et al., 2022a).

Analysis of Student Needs

Based on the results of the questionnaire used to analyze student needs, it was determined that students needed Entremaths as a mathematics learning method because teachers only provided material in the form of material sheets and student mathematics books from the Ministry of Education and Culture. In addition, the choice of Entremath is also due to students' learning styles which are mainly linguistic or easier to understand when reading and speaking. So this Entremath is perfect for these students. The learning method used by teachers is in the form of discussion and more often is a lecture or more explaining to students,

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besides mathematics learning, which is carried out has not been associated with the field of entrepreneurship, so a learning strategy that is more focused on students and related to the world of entrepreneurship is needed. In the learning process, students are accustomed to using technology such as *mobile phones* to support learning. Therefore, media in the form of electronic modules or Entremaths is suitable for use by vocational students.

Gap Analysis

According to an interview with a vocational mathematics teacher in Indonesia, students' ability to solve mathematical problems is still somewhat limited. One of the school's math teachers claims that even with a different approach from the one used to answer the preceding problem, many students are still unable to complete the supplied math problem. In addition, mathematics learning in the classroom often uses discussion and lecture methods. The material delivered by the teacher is only in the form of material sheets containing material points and questions, not material that can facilitate students' mathematical problem solving skills or that are integrated with problems in the field of *entrepreneurship*.

Material Analysis

Based on the results of literature studies, mathematical materials that are suitable for integration with the field of entrepreneurship in Entremath that will be developed are composition function material and reverse function.

2. Design Phase

The design phase is the second phase of this process. The creation and planning of entrepreneurship-based mathematics occurs at the design stage. Material composition functions and equations with inverse functions.

3. Development Stage

Using a validation test questionnaire, two mathematicians from Malaysia and Indonesia and two mathematicians from Malaysia and Indonesia validated the entrepreneurship-based mathematics that the researchers had developed.

The validation process is used to evaluate content eligibility, language feasibility, and media eligibility. Table 2 displays the results of validation tests conducted by three validators in Entremath's entrepreneurship-based mathematics program.

Table 2. Entremath validation test results

Aspects	Score Validator			Criteria
	1	2	3	
Relevant to mathematical material	4	3,75	3,75	• 1.00-1.50: Invalid • 1.51-2.50: quite valid • 2.51-3.50: Applicable • 3.51-4,00: Very valid
The application used is easily accessible	3,50	4	3,25	
Explore Troubleshooting	3,75	3,75	3,75	
Based on entrepreneurship	3.50	3,50	3,75	
As a study aid	3,75	3,50	3,75	
Can be used at junior high and high school level	3,5	3,75	3,5	
Sum	22	22,25	21,75	
Conclusion	3.67 / Very valid			

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According to the findings of validation tests by three validators shown in Table 2 of the results, *entremath* is valid with an average score of % from all three validators of 3.67 and belongs to the very valid category.

4. Implementation Phase

Entrepreneurship-based mathematics *Entremath* as Draft 2 is then implemented in the class that has been selected as an experimental class, namely class XI TKJ 1. In its implementation, the researcher takes on the role of a teacher under the supervision of one of the school's mathematics teachers. After the completion of the learning activity, student and instructor response

questionnaires are used to measure practicality tests. The findings of the practicality test of learning with the help of *Entremath*'s realistic and entrepreneurship-based mathematical models are described in the following paragraphs.

Based on questionnaires of student and teacher responses to learning using the *Entremath*-mate realistic model, the results of learning practicality tests with *entremath*-assisted mathematical realistic models were measured. After the learning was completed in 4 meetings, questionnaires were distributed with student and teacher responses. Table 3 below lists findings from surveys given to students and teachers.

Table 3. Results of student and teacher response questionnaire

Num	Student and Teacher Response Questionnaire	R (%)	Criterion
1.	Questionnaire of student responses to learning using realistic mathematical models assisted by entrepreneurship-based mathematics <i>Entremath</i>	86,9%	Very Practical
2.	Questionnaire of teacher responses to learning using realistic mathematical models assisted by entrepreneurship-based mathematics <i>Entremath</i>	96%	Very Practical

5. Evaluation Phase

Using posttest math problem-solving skills, this stage of learning is evaluated. Experimental and control classes accept posttests. After analysis, 34 of the 36 students in the experimental class were found to have completed their individual learning with a KKM score of 70 see Table 4.

Table 4. Completed KKM score of 70

Group	Pretest	Posttest
Experiment	15	34
Control	15	20

Based on Table 2, we can see that the number students who passed the KKM in posttest higher than pretest. It means

that using *Entremath* is one of the reason it can be happened.

Posttest results for experimental and control classes are also available. Posttest results for the experimental class and control class were compared using an independent sample t-test.

The results of the comparison test between the posttest scores of the experimental class and the control class, which did not use entrepreneurship-based mathematics, showed that the experimental class students' aptitude for solving mathematical problems was superior to that of the control class students. Entrepreneurship and math education uses realistic models that emphasize value creation.

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Discussion

The analysis phase is the first step in this development research method. The main problem with vocational schools at this point in the analysis is that students' ability to solve math problems is still lacking. Although the curriculum requires a learning process in which students serve as the center of learning, mathematics teaching still often uses lecture techniques.

In addition, the knowledge gained has not been connected with entrepreneurship despite the fact that there is a high probability that this entrepreneurship will be connected with the teaching of mathematics in vocational schools (Buckley & Futonge, 2016; Ramadhan et al., 2021). In addition, no books or other instructional aids are used in the study of mathematics. Only mathematics student books from the library of material sheets compiled by the teacher, which include only material points, are used as learning media. According to the findings of previous research, this is seen as less helpful for students' mathematics learning (Aminah, Sukestiyarno, Cahyono, et al., 2023).

The second stage of the process is design, and during design, entrepreneurship-based mathematics is used. Entremaths are created and prepared as Draft 1 and include content for inverse functions and compositions. After that, the Entremath program's development step—which is currently in Draft 1 was completed, and three individuals two mathematics instructors and one lecturer carried out the validation process.

It can be said that Entremath's entrepreneurship-based mathematics is valid to meet the eligibility criteria for content presentation, media feasibility, and language eligibility because the

validation results show that it is declared valid or feasible with an average percentage of 3.61 and is included in the very valid category. These results are in line with the study (Saimima et al., 2022).

Due to the fact that the questions presented in this Entremath must be solved through group discussion, it promotes a realistic learning process for mathematics. Problems in Entremath can be solved in a variety of ways, making them suitable for use in applications where mathematics is realistic. When students read this entrepreneurship-based math of Entremath, they are motivated and entrepreneurial characters begin to come to mind. The function of material composition and the reverse function is presented with an entrepreneurial narrative that elevates successful entrepreneurs.

Mathematics based on entrepreneurship Entremath is offered as a soft file in pdf format and offers information on composition functions and inverse functions. This is then sent via a link to the student. This was chosen because it is more accessible to students on computers or mobile devices.

After all, it saves storage space because there is no need to download programs to use it. Then, this reliable entrepreneurship-based mathematics program is used by Entremath. A math teacher and 36 pupils from the experimental class each received a questionnaire to complete as part of a practicality test.

Based on questionnaire analysis results of student and teacher responses to learning mathematics using realistic models of entrepreneurship-based mathematics, it was discovered that, on average, students answered 86.9% of the questions, while instructors

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answered 96.4 % of the questions, both supported the approach, both rated the experience as "Very Practical".

This implies that learning mathematics will be aided by entrepreneurship-based mathematics and realistic models of mathematics. Students and teachers respond well to Entremath because according to Nasution, learning is considered practical if it is well received by both parties when used in the real world (Yulando et al., 2019).

Posttest math problem-solving skills are used to evaluate learning after the next practice test enters the evaluation stage. Both practical classes and control classes accept posttests. After analysis, 34 of the 36 students in the practical class met their individual learning requirements with a KKM score of 70, achieving individual completeness with the grade. The experimental class also completed 75% of its classical education with grades. This indicates that at least 75% of students in practical courses have earned a degree. Up to 22 out of the 36 students in the control class did not reach individual learning completeness with KKM 70, according to posttest results. Both individual and classical completeness were not attained by these students. The posttest results of the experimental class and the control class were compared using a self-sample t-test with the following parameters.

The results of the posttest comparison test between the experimental class and the control class showed that the experimental class students' aptitude in solving mathematical puzzles was superior to that of the control class students, who did not use Entremath and learning with realistic mathematical models with value acquisition.

The benefit of this research is learning with mathematical realistic models combined with entrepreneurship-based mathematics Entremath on the material composition functions and inverse functions. Solving mathematical puzzles is one of the abilities that can help entrepreneurship, according to Mary Olukemi & Ezekiel Gbenga. Entrepreneurship and problem-solving abilities are closely associated (Yitshaki & Kropp, 2016) by combining entrepreneurship-based mathematical entremath and realistic mathematical learning models, it becomes an interesting combination to improve students' mathematical problem solving skills. In addition, research from Supriatna shows that one of the learning models, a realistic learning model for mathematics, is connected to entrepreneurship (Amalia & Sukestiyarno, 2021).

can increase students' capacity to solve mathematical puzzles. With the benefits of entrepreneurship-based mathematics discussed earlier, it also effectively motivates students to develop their entrepreneurial spirit through the use of basic skills found in Entremath's entrepreneurship-based mathematics. This is in addition to effectively improving students' math problem-solving skills.

CONCLUSION AND SUGGESSTION

The results of the development research conducted indicate that: (1) mathematics learning aided by Entremath's entrepreneurship-based mathematics was deemed practical with an average percentage of practice scores; and (2) mathematics learning using Entremath's entrepreneurship-based mathematics was deemed valid with validation results by three validators very valid category.

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The thoroughness discovered from the post-test comparison between the experimental and control classes demonstrates that the experimental class students' aptitude for resolving mathematical puzzles is greater than that of the control class students.

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