



# Reconstruction of Vocational-Based Mathematics Teaching Materials Using a Smartphone

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## ABSTRAK

Matematika merupakan salah satu mata pelajaran yang esensial bagi siswa SMK karena sangat dominan dalam mengembangkan ilmu pengetahuan dan teknologi. Penelitian ini bertujuan untuk menghasilkan bahan ajar matematika berbasis vokasi menggunakan smartphone yang memenuhi prasyarat valid, praktis, dan efektif. Model pengembangan yang digunakan dalam pengujian adalah ADDIE. Keabsahan materi yang ditampilkan disurvei oleh tiga spesialis materi dan tiga spesialis media menggunakan penilaian serta dianalisis menggunakan pengaturan Gregory. Hasil penilaian yang didapat bahwa materi yang ditampilkan memenuhi kebutuhan praktis. Perspektif kemudahan penggunaan dinilai dengan memberikan polling kepada peneliti penelitian menggunakan Client Experience Survey (UEQ) dan survei kepada siswa menggunakan pengujian Framework Convenience Scale (SUS). Hasil penilaian berdasarkan Client Experience Poll (UEQ) memperoleh nilai normal 89,56 dengan standar yang bagus. Konsekuensi dari penilaian Skala Kemudahan Penggunaan Kerangka diperoleh bahwa normal 89,44 diakui dan dalam jangkauan umumnya sangat baik. Keefektipan bahan ajar dinilai memberikan uji coba hasil belajar kepada siswa dan dibedah berdasarkan nilai kulminasi tradisional. Penghargaan pemenuhan tradisional diperoleh 97,5%. Kelebihan dari bahan ajar yang dibuat adalah pada foto, soal tes dan materi percakapan sesuai praktik untuk siswa SMK yang dapat dimanfaatkan siswa untuk belajar mandiri dan berkelompok, baik di dalam organisasi maupun di luar organisasi. Mengingat hasil ini, sangat baik dapat disimpulkan bahwa materi pembelajaran matematika berbasis vokasi menggunakan smartphone yang dibuat telah memenuhi komponen valid, praktis, dan efektif sehingga dapat dimanfaatkan selama pembelajaran.

## ABSTRACT

Mathematics is one of the essential subjects for vocational students because it is very dominant in developing science and technology. This study aims to produce vocational-based mathematics teaching materials using smartphones that meet the valid, practical, and effective prerequisites. The progressing model used in the test is ADDIE. The validity of the featured material was surveyed by three materials specialists and three media specialists using an assessment and analyzed using the Gregory arrangement. The results of the assessment obtained that the material displayed meets practical needs. The ease of use perspective was assessed by giving a poll to research researchers using the Client Experience Survey (UEQ) and a survey to students using the Framework Convenience Scale (SUS) test. The assessment results based on the Client Experience Poll (UEQ) obtained a normal value of 89.56 with a good standard. As a consequence of the Ease of Use Framework assessment, it was found that normal 89.44 was recognized and within the range of generally very good. The effectiveness of teaching materials is assessed to provide a trial of learning outcomes to students and dissected based on traditional culmination values. Traditional fulfillment awards earned 95%. The advantages of the teaching materials are photos, test questions, and conversational materials according to practice for vocational students, which students can use for independent and group study, both within and outside the organization. Given these results, it can be very well concluded that the vocational-based mathematics learning materials using smartphones have fulfilled the valid, practical, and effective components to be utilized during learning.

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## 1. INTRODUCTION

The quality of human resources can be improved by improving the quality of education and formal training (Retnawati et al., 2011; Siripongdee et al., 2021). One of Indonesia's formal forms of education is SMK, a secondary education that explicitly prepares. Facing the competition of labor expertise in this era of globalization, vocational education is required to improve the quality of education and develop learning and evaluation concepts to be able to provide significant results to the improvement of expertise or competence (Sumandya et al., 2021; Verawadina et al., 2020). Related to the issue of educational development at the

international level, the Indonesian government designed the 2013 curriculum with various improvements. The first standard of content, which is to reduce irrelevant subject matter as well as deepen and expand relevant material for students and enrich the student's need to think critically and analytically following international standards (Shang-ling, 2019; Yudistira et al., 2016). The 2013 curriculum is more geared towards equipping students with several competencies needed to meet the 21st century (Bialik et al., 2015; Ghavifekr et al., 2016; Yudela et al., 2020). Some important competencies required in the 21st century are 4C, including Critical thinking skills, which aims the students can solve various contextual problems using critical and rational logic. Creativity encourages students to creatively find solutions, design new strategies, or find common ways to use them before. Collaboration (cooperation) facilitates students to have the ability to work in teams, be tolerant, understand differences, be able to live together to achieve goals. Communication facilitates students to be able to communicate broadly, the ability to capture ideas or information, the ability to interpret information, and the ability to argue in the broadest sense (Widana, 2018; Yu & Mohammad, 2019).

The structure of the vocational curriculum in Indonesia places mathematics subjects as compulsory subjects and is in group B. Mathematics is one of the essential subjects for vocational students because it is very dominant in developing science and technology (Murtinugraha, 2017; Telles, 2019; Uran, 2018). Mathematics is a subject that can foster creativity and emphasize critical thinking (Antara et al., 2020; Ruhimat & Rosdiana, 2020). Math learning can guide students to get used to dealing with problems so that students are accustomed to thinking numerically, specifically wisely, naturally, and fundamentally (Rahmani & Widyasari, 2018; Siregar et al., 2011). However, some vocational students consider mathematics to have nothing to do with the vocational they are pursuing so their interest in math lessons is shallow. The above statement is evidenced by the results of questionnaires and analysis shared with vocational students providing information that vocational students are more interested in learning productive subjects or vocational learning than learning mathematics. In addition to student questionnaires and responses, students' math repeat average scores were lower than productive subjects. More students gained math scores under KKM than students who scored above KKM. Overcoming these problems needs to be developed teaching materials related to vocational or study programs selected by students. Vocational-based math learning using smartphones was chosen as an alternative because it follows the demands of learning in the technological era. Through this smartphone, vocational-based mathematics teaching materials can be used as an alternative as an existing learning companion and as a support for the 2013 curriculum book developed by the Indonesian government. So far, there has been no vocational-based math teaching material through smartphones circulating in vocational schools, so this becomes a need to increase student's interest in studying mathematics..

In line with research that shows that students are very passionate about handling numerical statements related to the vocational, they are engaged in (Sumandya, 2020). The exam coordinated by Sumandya is very focused on assessment, so the shortcoming of this study is that the arithmetic findings that have been done have not linked prophetic learning with mathematical learning. In addition, similar studies have also observed that vocational-based math learning can further develop student agreement, and students take part in learning systems and provide energetic reactions to math learning (Edo & Tasik, 2019). Mathematics learning should connect mathematical information with the information and practice of vocational students. Fatimah's exploration is limited to supporting examinations. Fatimah only examined the side effects of past scientists without directing trials or testing in the field. Looking at the explanation above, it seems that past experts have not created vocational-based mathematical teaching materials using smartphones. Analysts have created vocational-based mathematical teaching materials using smartphones to deal with this problem. This is done so that professional school graduates are ready to compete and have outstanding character even though 4.0 has advanced. The advantage of this test is the utilization of professional-based numerical problems related to professional student activities that students can use to gather freely or in association. Using a smartphone. This research aims to produce vocational-based math teaching materials using smartphones that meet valid, practical, and effective prerequisites.

## 2. METHOD

This Research was an R&D. Researcher who developed vocational-based mathematics teaching materials using smartphones for students and teachers of class XII VOCATIONAL. The quality of teaching materials in this study was seen from three aspects, namely the validity aspect, the usability aspect, and the effectiveness aspect. The test subjects used in this study were adapted to the stages of research. The purposive sampling technique is done because in development research, the most important thing is finding shortcomings and getting suggestions for prototype improvements developed (Adiarta, 2019). The product trial involved 40 students and math teachers at SMK Wira Harapan. The model used in this study was the instructional design of the ADDIE (*Analyze, Design, Develop, Implement, and Evaluate*) model modified by AECT for the U.S. Army

to be more dynamically written *in-branch* into design with formative and summative evaluation. This research uses formative evaluation during development, while summative evaluation was done after the trial.

**Table 1.** ADDIE Model Design Phase

Analysis	The author's stages of analysis include three things, namely needs analysis, curriculum analysis, and student character analysis. The results of the analysis on this activity are called the initial draft..
Design	Determine draft 1 characteristics of vocational-based mathematics teaching materials using a smartphone. Decision-making through FGD.
Development	The development stage is the product realization stage. At this stage the development of vocational-based mathematics teaching materials using smartphones is carried out following draft 1. The product is called a prototype, evaluation (validation) using expert tests and gregory formula analysis.
Implementation	Carry out trial learning to improve the quality of the product. Evaluation is carried out to test the media's usefulness, both from the teacher's side and from the student's side. In terms of teachers using User Experience Questionnaire (UEQ). From the student side using the System Usability Scale (SUS).
Evaluation	Evaluate so that the final product is obtained.

(Cahyadi, 2019)

The evaluation used expert tests and analysis using Gregory formulas. Validity data was obtained from assessments by material experts and media experts who collaborated with researchers in learning. In terms of teachers using User Experience Questionnaire (UEQ). From the student side, using the System Usability Scale (SUS). Respondents responded by scoring products from 1 (strongly disagree) to 5 (strongly agree) on the ten items of the question. Each statement item had a contribution score. Each item's contribution score will range from 0 to 4. The odd item of the contribution score was the position of the scale minus 1, while for even items the contribution score was 5 minus the position of the scale. Next multiply the number of contribution scores by 2.5 to get the overall value of the usability system. SUS scores range from 0 to 100. Here is the formula for calculating the SUS score (Yalcin, 2020). Teaching materials were said to meet usability values if they meet the classification of teaching material assessments at least well.

The study results test was used to measure the possible benefits of teaching materials. The information was obtained by investigating the results of student-led learning outcome tests against the completion of examples. The way taken were: (1) Ensuring the value of each student's learning outcomes; (2) Determine the value achieved by each student with the equations that come with it; (3) Include the number of students who pass KKM, especially individuals who obtained a fundamental score of 75; (4) The value of traditional culmination by utilizing the accompanying recipe. Teaching materials were effective if the percentage of completion of classical learning achieves a good minimum classification.

### 3. RESULT AND DISCUSSION

#### Result

##### Validity Analysis Results

As for the results of expert validation of material as in Table 2

**Table 2.** Material Expert Validation Result

Aspect	Average
Content Eligibility	0.86
Presentation Eligibility	0.86
Language Assessment	0.85
Learning Assessment	0.88
<b>Average Total</b>	<b>0.86</b>

Based on the analysis results, the average value obtained was 0.86 then the assessment by material experts was in the range of scores  $> 0.7$  based on guidelines set by teaching materials developed was said to be valid by material experts. The teaching material developed was declared feasible by material experts because it met the feasibility of content, presentation feasibility, language assessment, and learning assessment. The content of the material on the teaching material was following the characteristics of vocational students. Interesting

presentation to make students enthusiastic about learning the material presented on teaching materials. The language used in communicative teaching materials encourages students' interest in learning. The average validation result of media experts was 0.84, then the assessment by media experts was in the range of scores  $> 0.7$  based on guidelines so that the teaching material developed was said to be valid by media experts because the display of layout elements on the face cover, back and back harmoniously has rhythm and unity and consistent, composition and size of layout elements (title, author, illustration, logo, etc.) proportional, balanced and in harmony with the content layout (according to pattern), harmonic color layout elements and clarify functions, describe the content or teaching material and reveal the character of the object and form accurately and proportionally by the vocational selected student.

### Usability Analysis Results

The product trial involved 40 students and math teachers at SMK Wira Harapan. The usability aspect was evaluated by providing questionnaires to teachers using *User Experience Questionnaire (UEQ)* and questionnaires to students whose analysis used *the System Usability Scale (SUS)*. The evaluation results based on UEQ obtained an average of 89.56 in the range of  $75\% < X \leq 90\%$  with good criteria. SUS evaluation results obtained an average of 89.44 received and were in the very good range. Vocational-based math learning using *a well-developed smartphone* was useful in learning. Vocational-based math lessons using smartphones were said to meet the usability aspect due to positive responses from students and teachers during learning. Based on the observation results, students and teachers did not experience significant obstacles during learning. Students felt satisfied to learn mathematical materials because of several things, namely: mathematics was strongly related to the vocational chosen by students, teaching can be used in networking and outside the network without having to take textbooks everywhere, including discussion materials that free students to explore the knowledge that they has in groups, the answer key formative test in the form of video, this causes students to be able to learn independently anywhere and anytime, the evaluation of competence contains answer keys available in the network and outside the web, so that students are free to choose according to their comfort of learning and can be done repeatedly until they find the correct answer.

### Effective Analysis Results

The learning outcome test was given to students at the end of learning to determine the completion of the student's understanding after the learning was completed. Test results were used to determine the average percentage of test scores of student learning outcomes. Test results obtained a percentage of classical completion of students to find out the effectiveness of learning, as for the recapitulation of student learning tests on trials as in Table 3.

**Table 3.** Recapitulation of Students' Field Trial Test Result

Acquisition	Result
Number of Students who completed	38
Number of Students who are not completed	2
Classical Completion Percentage	95%

In the trial involving 40 students, only 2 people did not meet the minimum score because they were not complete when doing the test, they were less physically healthy. The classic completion percentage of 95% was in the  $p > 80$  range with an Excellent classification. According to the guidelines set, based on the conversion table, vocational-based mathematics teaching materials using smartphones were effectively used in learning so that students' grades become complete. The cause of student learning outcomes increases because (1) During learning, students were actively involved in resolving problems given to teaching materials; (2) Students learn indefinitely by space and time; (3) discussions conducted in the network or outside the network make students interested in learning because it was not bound by space and time; (4) Vocational problems provided at the beginning of learning make students felt comfortable studying the materials provided in teaching materials; and (5) Students felt the mathematical material studied, relating to their chosen vocational.

### Discussion

Vocational-based mathematics teaching materials using *smartphones* developed have fulfilled the validity aspect of the content because it is following the applicable curriculum and by the theories used as a foundation in the development of this teaching material (Arum & Wahyudi, 2016; Qin et al., 2014; Tegeh et al., 2015). At the same time, the validity of the construct is assessed based on the interrelationships between the various components that make up the product which is evaluated from the depth aspect of matter and media (Setyosari & Djatmika, 2021; Feces et al., 2017; Wahyuningtyas & Shinta, 2017). Teaching materials developed in this study have produced the characteristics of vocational-based math teaching materials using smartphones.

The teaching materials developed have been under the characteristics of vocational-based mathematical learning using a smartphone. The teaching materials developed have been fulfilled and are under content feasibility such as conformity of material with the basic competency, the accuracy of the material, supporting learning materials, material update. Researchers have successfully developed vocational-based math teaching materials using smartphones based on the above exposure. Characteristics of teaching materials developed are: picture, examples of questions and discussion materials by the vocational practice of vocational students; sound can be muted if disturbed; evaluation and ability checks can be done in connection and outside the network; asked students discuss both in the network and outside the network before doing formative test; The formative test answer key is video.

The teaching materials developed have to learn characteristics such as: directing students to start learning from vocational-based statistical problems related to the practice of vocational students at the beginning of learning; directing students to develop vertical instruments (Charts, Models, Schemas) discussed in groups; directing students using the results of student work and constructing them; the existence of discussion questions that can cause interactivity in the network and outside the network; The relationship of mathematics material with the vocational subject matter. While the principle of learning statistics based on vocational education integrated character education was a problem that leads students to rediscover with guidance and progressive mathematics of the issues that were done in groups; contains didactic phenomena; some questions stimulate students to be able to develop their models. These findings support research conducted by several previous experts. Research entitled *Developing Assessment of Vocation-Based Hots on Mathematics Subject for X Class of Vocational School* shows that students are very passionate about recording math questions related to the professionals they are involved in. The assessments made are seen from legitimacy, common sense, and survival (Sumandya, 2019). In line with such research, research observing that vocational-based math learning can further develop student agreement. Students take part in learning systems and provide energetic reactions to math learning (Edo & Tasik, 2019; Rokhmah et al., 2019). In addition, mathematics is not just a tool to solve problems but must serve as an actual mindset formation and foster a positive attitude for vocational students to be able and adaptable (Effendi, 2017; Snegurenko et al., 2019; Utama et al., 2015).

Nature and flexibility are driven by vocational students so that they are basic, inventive, and ready to develop themselves by opportunities and the world of work. Effendi excelled at fostering pyramid education plans, particularly Mathematics, IPA, Sociology, and Language forming a square shape as the foundation of the pyramid. The Ability Program as its pinnacle shows that helpful illustrations in Vocational High Schools should be upheld by arranging and versatile examples. The side of the above review is that vocational-based math learning further excites students to learn mathematics. Sumandya and Widana also researched *Developing Vocational-Based Mathematical Learning Scenarios for Students of Class XII VOCATIONAL*. Scenario design made legitimate, feasible, and successful for vocational student learning (Sumandya, 2019). Given the results of exploration and some supporting hypotheses, it was concluded that science learning should link numerical information with vocational information and practices in accordance with key fields of study and use innovation so that professional mathematical learning objectives were ideally achieved.

#### 4. CONCLUSION

This study concludes that researchers have successfully developed vocational-based mathematical teaching materials using smartphones. The results of this study also get the characteristics of teaching materials such as examples of questions and discussion materials following the vocational students' practice. At the same time, the characteristic of learning is to direct students to start learning from vocational-based statistical problems related to the practice of vocational students at the beginning of learning. The principle of learning statistics based on vocational education integrated character education is. Some suggestions that can be given include: use this teaching material to facilitate the understanding of mathematical concepts; for those who want to apply this teaching material, then as much as possible analyze again to be adjusted its application, especially in the provision of facilities and infrastructure in schools where this teaching material is applied; mathematics learning in vocational school as much as possible uses vocational-related learning chosen by students, so that learning is more meaningful for students; Learning in vocational school as much as possible utilizing technology so that students can learn anywhere and anytime.

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