

# Development of mathematics learning devices based on realistic mathematics education for financial accounting expertise program in vocational high school (preliminary research)

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**Abstract.** Financial Accounting is one of expertise programs in Indonesia Vocational High Schools. The prospective Vocational High School graduates are expected to be equipped with a great problem-solving skill which demanded in the field of working. Mathematics is the lesson that develop students' problem-solving skill. This paper discussed development in learning devices based on realistic mathematics education for financial accounting expertise program in Xth grade Vocational High School. The research was conducted until preliminary research phase by using Plomp model. Based on the interview results conducted on Mathematics teachers in SMK N 2 Padang and SMK N 3 Padang, the writer concludes that the mathematics learning devices commonly used by teachers are general without giving differences in the characteristics of each expertise program, specifically in financial accounting programs. Lastly, students have low mathematics problem-solving skill.

## 1. Introduction

As the rapid growth of technology and globalization in South East Asia with its ASEAN economic community, human resources and deployment, especially in Indonesia, faces new challenge. In order to keep up with it, Indonesia education should come out with better strategy to prepare and develop highly competitive human resources. One of the suggested efforts is improving the quality of Vocational High School (VHS) education. Prospective vocational school graduates are expected to be well-prepared with proficient field of expertise and work professionally.

As written in Act of Republic Indonesia No. 20 Article 15 in 2003 [1] related to National Education System, it states that VHS is secondary high school in preparing students to work in specific field. VHS must fill the high standards as demanded in working world. However, it fails to meet the expectation. VHS scores high numbers on national unemployment rates [2]. Data from Indonesia Central Statistical Agency shows that VHS hit 17,26 % in unemployment rates. In addition, Asian Development Bank survey states that prospective vocational graduates fail to meet employers' demand [3]. The reason behind such failure is lack of soft skills [4]. One of the most important skills in working world, based on NACE (National Assosiation of College and Employers) is problem-solving [5]. Hence, developing problem-solving skill can be acquired in mathematics. One of mathematics learning objectives, as stated in Ministry of Education Regulation Number 59 Year 2014



[6], is mathematical problem-solving skill.

Based on the Director-General of Primary and Secondary Education Decree Number: 130/D/KEP/KR/201: February 10, 2017 concerning the Curriculum Structure of Vocational Secondary Education (SMK / MAK), VHS has nine areas of expertise: (1) technology and engineering, (2) Energy and mining, (3) Information and Communication Technology, (4) Health and Social Work, (5) Agribusiness and Agrotechnology. (6) Maritime Affairs, (7) Business and Management, (8) Tourism, and (9) Art and Creative Industry. One of the most interested by the community is financial accounting expertise program.

In this fast pace of globalization, career opportunity for proficient experts in accounting and financial expertise program is widely open. According to Central Statistics Agency data in 2016, Indonesia as a developing country has a fairly rapid economic growth, which is 5.02%. Moreover, International Monetary Fund (IMF) predicts that Indonesia economic growth in 2023 will rise up to the sixth position as the country with the largest economy, leaving Russia, Brazil, England and France behind.

Every company needs professionals in managing the company's finances. This is a great opportunity for financial accounting graduates to take part in working world. Problem-solving skill is important for students in financial accounting to face competitive environments. Accountants must make the call, solve the problem quickly and identify great opportunities while in the same time reducing risk at all cost. Accountants who have problem-solving skills are the biggest asset to solve complex financial and non-financial problems efficiently.

Based on writer's observation at Xth Grade in SMK N 2 Padang and SMK N 3 Padang in April 2019, students has low interest in learning mathematics. Some thought that mathematics is the most difficult subject while other said mathematics was not important topic since it did not directly influence their daily life. It leads to their unwillingness in learning mathematics. In addition, learning devices provided is too general. It indicates that the lesson plan are not designed solely for financial accounting expertise program. in figure 1 and 2 were teachers' lesson plans.

PEMERINTAH PROVINSI SUMATERA BARAT  
DINAS PENDIDIKAN  
**SMK NEGERI 2 PADANG**  
Bidang: Diklat, Kejuruan, Bina Kesiswaan, Teknologi, Inovasi dan Penelitian, Seni, Rangkaian dan Fasilitas  
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**RENCANA PELAKSANAAN PEMBELAJARAN (RPP)**

NAMA SEKOLAH	: SMK N 2 PADANG
MATA PELAJARAN	: MATEMATIKA
KOMPETENSI KEAHLIAN	: SEMUA PROGRAM KEAHLIAN
SEMESTER	: I (GANJIL)
KELAS	: X
MATERI POKOK	: PERTUMBUHAN, PELURUHAN, BUNGA DAN ANUITAS
ALOKASI WAKTU	: 3 x 45' (@85MENIT)
PERTEMUAN KE	: 22, 23, 24

A. Kompetensi Inti (KI)

KI.3 Memahami, menerapkan, menganalisis, dan mengevaluasi tentang pengetahuan faktual, konseptual, operasional dasar, dan metakognitif sesuai dengan bidang dan lingkup kajian matematika pada tingkat teknis, spesifik, detil, dan kompleks, berkenaan dengan ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dalam konteks pengembangan potensi diri sebagai bagian dari keluarga, sekolah, dunia kerja, warga masyarakat nasional, regional, dan internasional.

Figure 1. Mathematics Lesson Plan in SMK Negeri 2 Padang

**RENCANA PELAKSANAAN PEMBELAJARAN**

Nama Sekolah	: SMK N 3 Padang
Kompetensi Keahlian	: BISMEN DAN TIK
Mata Pelajaran	: Matematika
Materi Pokok	: Sistem Persamaan Linear Dua Variabel (SPLDV)
Kelas/Semester	: XI/I
Tahun Pelajaran	: 2018/2019
Alokasi Waktu	: 4x45 menit (1 x pertemuan)

A. KOMPETENSI INTI

3. Memahami, menerapkan, menganalisis, dan mengevaluasi tentang pengetahuan faktual, konseptual, operasional dasar, dan metakognitif sesuai dengan bidang dan lingkup kajian matematika pada tingkat teknis, spesifik, detil, dan kompleks, berkenaan dengan ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dalam konteks pengembangan potensi diri sebagai bagian dari keluarga, sekolah, dunia kerja, warga masyarakat nasional, regional, dan internasional.

Figure 2. Mathematics Lesson Plan in SMK Negeri 3 Padang

As presented in figure 1, the lesson plan designed was for all vocational expertise program. Similarly, figure 2 lesson plan was written for two expertise programs, Business Management and

Information Technology & Communication. It clearly indicates that the learning devices was not designed for one specific expertise program. Moreover, teachers did not use any students worksheets in teaching learning process. Thus, students have low ability in solving mathematics problem. The hypothesis became clearer after the test involving problem-solving question was given to the students. The test result showed that only 40% of financial accounting students in SMK N 3 Padang scored at last 60 points. Correspondingly, 28% students in SMK N 2 Padang scored above 60 points. It means that more than half of the financial students have low problem-solving skill. This paradigm is caused their tendency to treat mathematics as unimportant subject and some give up early knowing mathematics is a difficult subject.

Mathematics is the less liked subject in most VHS [7]. They think that there is no correlation between mathematics and their area of expertise. Strangely, the textbook and learning materials provided in VHS follows senior high school guidelines. While it was so obvious, the learning objectives are not on the same boat. To solve this predicament, these should be a real action taken to motivate students in learning mathematics.

The most likely attainable approach can be taken is developing mathematics learning devices. Teachers' learning devices is the main guidelines for conducting teaching and learning process. Ministry of Education and culture regulation No 65 Year 2013[8], regarding Standard process of Primary and high school education states that designing learning devices is a part of teaching plan to improve students' learning ability and to achieve learning objectives. Therefore, some improvements for learning devices should be made. Designing learning devices needs to consider the appropriate material with its corresponding expertise program to attract students' attention and enhance problem-solving skill. The writer suggests to develop learning devices, lesson plan and students' worksheets, based on realistic mathematics education (RME).

Realistic approach emphasizes on the use of real life as learning starting point, reality is concrete things that can be observed or understood by students through imagination [9]. In short, RME approach uses students' environments (family, school, society) as contextual problem. As reflected in RME steps, the first step is identifying known elements in order to find the indicator. The second step is explaining contextual problem, finding the root of the problem and applying a proper strategy to solve it. To sum up, RME is not only solving contextual problem, but also involves explaining, interpreting the root problem and drawing conclusion.

Based on the problems found, the researcher wanted to conduct a research development entitled "The Development of Mathematics Learning Devices Based on Realistic Mathematics Education for Financial Accounting Expertise program in Vocational High School."

## 2. Research Methods

The current research is a part of development research. Development research is a research method used to develop or validate products used in education and learning [10]. The development model used is the Plomp model. Preliminary research includes needs analysis, curriculum analysis, concept analysis and student analysis [11]. Those analysis are required to collect data, analyze and identify problem which likely happen in teaching and learning process, it also can be used as a basis for determining alternative solutions and measuring what kind of product needed to solve it. Due to time limitation, only to stages of development research were conducted, curriculum analysis and student analysis.

Descriptive research is used in completing this paper. The sample in this study was students of Xth grade expertise program in financial accounting in SMK N 2 Padang and SMK N 3 Padang. Data gathering instruments are interview guide sheets, observation sheets, and documentation. The data divided and analyzed separately such as results of learning observation, interview results, and document analysis.

## 3. Results and Discussion

To find out basic competencies in VHS, K-13 curriculum was inspected which include mathematics and productive subjects. Due to time limitation, curriculum analysis only covered the first semester topics. Stand on Ministry of Education and Culture regulation, 130/D/KEP/KR/2017 [12], the topics taught in odd semester are (1) Exponentiation, roots, and logarithm (2) absolute values equations and inequalities of (3) Linear equations with two variables (4) linear programming (5) arithmetic sequences and series (6) geometric sequences and series (7) growth, decay, interest, and annuity. Based on interview results, the seventh topic : school, growth, decay, interest and annuity was not taught in the first semester. It will be taught briefly at the beginning of the second semester. Even though, it is important for financial accounting student to learn it, the limited allocated time for the second semester only allows them to grasp just small amount of information. Hence, they must learn it independently.

The next thorough observation is on mathematics basic competencies and financial accounting subject basic competencies. It turned out that not all of basic competences are implemented in teaching and learning process. These following subjects have appropriate basic competencies with its area of expertise. Some productive subjects for financial accounting expertise program include : (1) Simulation of Digital Communication system (2) Business Economics (3) Application for Processing Numbers/ Spreadsheets, (4) Basic Accounting (5) Basic Banking, (6) Practical accounting for Trade, service and Manufacturing Companies, (7) Financial Accounting, and (8) Computer Accounting. The result of curriculum analysis can be seen in Table 1 below.

**Table 1.** Basic competencies (BC) for mathematics and basic competencies (BC) for financial accounting subjects in the first semester.

Mathematics BC		Productive Subjects BC	
Field of Knowledge	Field of Expertise	Field of Knowledge	Field of Expertise
3.1 Applying Exponentiation, roots, and logarithm in solving problem.	4.1 Able to solve Exponentiation, roots, and logarithm problem.	<b>A</b> 3.1 Applying computer logic and algorithm	<b>A</b> 4.1 Able to use computer's commands
3.2 Applying absolute values equations and inequalities	4.2 Present problem related to absolute values equations and inequalities	<b>B</b> 3.12 Applying economics in business activity	<b>B</b> 4.12 Able to implement economics skill in business activity.
3.3 Determining the variable value on Linear equations with two variable	4.3 Able to solve Linear equations with two variable problem	<b>B</b> 3.3 Understanding the model, economic actors, consumer and producer behavior in economics activity	<b>B</b> 4.3 Able to determine the model, economic actors, consumer and producer behavior for future business demand.
		<b>G</b> 3.6 Taking note of short-term debt (purchase goods on credit, notes, installment purchase , tax debt, accrued salaries payable, and prepaid income)	<b>G</b> 4.6 Able to record short-term debt (purchase goods on credit, notes, installment purchase , tax debt, accrued salaries payable, and prepaid income)
		<b>H</b> 3.5 Analyzing transaction for purchasing materials, supplies, fixed assets and debt payment on a service company.	<b>H</b> 4.5 Able to do data entry of transaction for purchasing materials, supplies, fixed assets and debt payment on a service company
3.4 Determining	4.4 Able to solve	<b>B</b>	<b>B</b>

minimum and maximum points of linear programming in contextual problem	contextual problem in linear programming.	3.5 Calculating production costs and profits (cost theory) <b>F</b> 3.22 Recording cash disbursement transactions for material purchases, pay direct labor costs, factory overhead cost, general and administrative expense, marketing costs, paying off trade debts, and other debts into journal. <b>G</b> 3.10 Analyzing manufacturing cost for the company. <b>C</b>	4.5 Able to Calculate production costs and profits (cost theory) <b>F</b> 4.22 Able to keep track and record cash disbursement transactions for material purchases, pay direct labor costs, factory overhead cost, general and administrative expense, marketing costs, paying off trade debts, and other debts into journal <b>G</b> 4.10 Able to list all prices manufacturing cost <b>C</b>
3.5 Analyzing arithmetic sequences and series	4.5 Able to solve problem related to arithmetic sequences and series	3.2 Data Entry 3.3 Data entry using characters in cell 3.4 Data entry using math formula. <b>D</b>	4.2 Data processing 4.3 Data processing using characters in cell 4.4 Data processing using math formula <b>D</b>
3.6 Analyzing geometric sequences and series	4.6 Able to solve contextual problem related to geometric sequences and series	3.8 Using journals, debit and credit concepts, normal balances, systematic recording, and journal. <b>E</b>	4.8 Able to record debit and credit concepts, normal balances, systematic recording, into journal. <b>E</b>
3.7 Analyzing growth, decay, interest, and annuity.	4.7 Able to solve problem related to growth, decay, interest, and annuity	3.7 Analyzing giro deposit account 3.8 Analyzing deposit and saving account 3.9 Analyzing deposit funds 3.10 Evaluating bank credit <b>F</b> 3.16 Analyzing transactions for adjust entry for supplies, costs of depreciation of fixed assets, rent expenses, insurance costs, interest costs, receivables expense, adjustments to income interest, bankreconciliations, and fiscal adjustments. <b>G</b>	4.7 Able to count giro deposit account 4.8 Able to count deposit and saving account 4.9 Able to count deposit funds 4.10 Able to prepare banking credit reports <b>F</b> 4.16 Able to record transactions for adjust entry for supplies, costs of depreciation of fixed assets, rent expenses, insurance costs, interest costs, receivables expense, adjustments to income interest, bank reconciliations, and fiscal adjustments. <b>G</b>
		3.1 Analyzing the record	4.1 Able to record goods



	of Goods sold on credit, money orders, and installment sales	sold on credit, money orders, and installment sales
	3.2 Applying receivables measurement and recognition	4.2 Able to measure receivables measurement and recognition

**Description:** A = Simulation of Digital Communication system;

B = Business Economics;

C = Application for Processing Numbers / Spreadsheets;

D = Basic Accounting;

E = Basic Banking;

F = Practical accounting for Trade, service and Manufacturing Companies;

G = Financial Accounting;

H = Computer Accounting.

In Table 1, mathematics basic competencies can be linked to several productive subjects basic competencies. The context of productive subjects can be integrated as an initial problem in the process of learning mathematics. This will certainly attract students' interest and attention since it will finally make them realize how mathematics is implemented in the other relevant subjects.

Students analysis is conducted to measure students' characteristics related to academic ability, environment, students' tendency in learning, and their preference on learning material. The results will be used as a guidelines for writer in development stage or prototype stage. Thus, the students' worksheets will be able to cover all students' needs. Students analysis is completed through interview. The result showed that students are more happy to learn productive subjects rather than mathematics. They always assume mathematics is a difficult subject and is unnecessary to learn since it is not implemented in daily life.

Students have difficulty in solving application problems of mathematics, this effect in students' mathematical problem-solving skill is still low. Students difficult to find the benefits of learning mathematics for their expertise program. To foster interest and motivation to learn there needs to be a learning process that starts with things that are in their environment. Mathematical problems that are presented about students' expertise program can motivate them to be active during learning so that more meaningful learning is created. The use of contexts that are close to their environment is one of the characteristics of the RME approach.

After completing curriculum analysis and student analysis, the problems presented can vary related to the financial accounting expertise program. Therefore, one solution which will overcome these problems is developing a mathematics learning devices based on Realistic Mathematic Education (RME) for financial accounting expertise program. This learning devices is designed to fulfill students' needs and it has all element of great characteristic for lesson plan and student's worksheets. As the result, the expected learning devices is able to enhance students' problem-solving skill for financial accounting students.

#### 4. Conclusion

Based on observation and interview results, students prefer to learn productive subjects rather than mathematics, because it has insignificant effect in daily life. Students find it difficult to solve mathematics problem since they have low problem-solving skill. With the help of RME based learning devices, writer expects it will increase students' motivation and interest in learning mathematics, improve students' problem-solving skill, and lastly develop skilled prospective vocational high school graduates.

## 5. References

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