Analysis introduction of the development of mathematics learning device based of professional competency in electrical engineering programs vocational high school class X

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Abstract. Based on preliminary research in SMKN 1 Koto Balingka and SMKN 1 Lembah Melintang obtained information that student's math problem solving ability are still low. One of the contributing factors is that the mathematics learning device has not facilitated students to improve their math problem solving skills and students assumptions that mathematics is not important to learn because it is not related to student's expertise program. It become the basis for developing learning tools like RPP and LKPD based on expertise competency in the electricity engineering expertise program for students of SMK class X. The electricity engineering expertise program was choosen in this study because there was no math learning device that is in accordance with the electricity expertise program. The preliminary analysis phase is carried out by observation, interview with teachers and students and tests of math problem solving skills. The research subjects were grade X of SMKN 1 Koto Balingka. The type of research is development research using PLOMP models that consist of preliminary research, in the form of needs analysis, curriculum analysis, concept analysis and analysis of students.

1. Introduction
Vocational High School Education (SMK) as a secondary level vocational education has a major role in planning and creating professional and productive human resources. The aim of the Vocational School is as one of the institutions that prepare the workforce which is demanded to be able to produce graduates as expected by the world of work. According to the explanation in Article 15 of Law No. 20 of 2003 concerning the national education system, it explains that "Vocational High School is secondary education that prepares students to work in certain fields". Vocational Middle School as one of the educational institutions that has a mission to prepare mid-level workforce capable of filling employment and professional quality is expected to be able to play a superior tool for Indonesian industries in facing global competition.

The above is very contrary to the fact that there are vocational school graduates who are the biggest contributors to the unemployment rate in Indonesia, which is 8.92% followed by Diploma I-III at 7.92%, High School (SMA) by 7.19%, University 6.31%, Junior High School (SMP) 5.18% and elementary school graduates down only 2.67% in February 2018 (detik.com).

In vocational schools there are terms of expertise competencies which are part of education in a vocational high school. Furthermore, there is another term of expertise program which is actually a
collection of several competency skills, and a collection of some of the core end-of-expertise programs is the Field of Expertise. Electricity engineering is one of several expertise programs in the field of technology and engineering expertise.

Problem solving is a standard of ability that must be possessed by all students after completing a lesson. George Polya (1973) stated "The ability to solve problems is the process taken by someone to solve the problems they face until the problem is no longer a problem for him". Meanwhile Usman (2014:21) states that "problem solving is one of the competencies that is the focus in learning mathematics". Based on the above opinion it can be concluded that problem solving ability is an ability that is the main concern in mathematics learning and aims to help students in solving mathematical problems so that the problem is no longer a problem for students.

In fact, the problem solving ability of students is still not optimal. This can be seen from several previous studies. Research conducted by Purwosusilo (2014) shows that the ability to solve mathematical problems in class X vocational high school students is still low, resulting in low learning outcomes. In addition, the research conducted by Hikmah (2016) showed that the average mathematics problem solving ability of students in grade X was still low. Based on the conclusions of several researchers, it was seen that students' problem solving abilities were still low.

The above problems were also encountered when conducting a preliminary study on March 26 and March 28 2018 at State Vocational High School 1 Koto Balingka and State Vocational High School 1 Lembah Melintang and the test of students' problem solving abilities at SMK 1 Koto Balingka on April 16, 2018. The preliminary study was conducted with interviews with teachers and students of class X semester 2 of the academic year 2017/2018 on mathematics lessons and gave a test of problem solving abilities.

Based on interviews with mathematics teachers at SMK Negeri 1 Koto Balingka and SMK Negeri 1 Lembah Melintang regarding problem solving abilities, information was obtained that students' problem solving abilities were still low. This is caused by several things, namely the low interest in students' mathematics learning because they assume that mathematics is a difficult lesson as a result students are less motivated to understand a material. Besides that the learning process is still teacher oriented, this is certainly not in accordance with the demands of the 2013 curriculum which requires an educational process to provide opportunities for students to develop all their potential.

The results of interviews with students also obtained information that mathematics lessons are lessons that are tedious and difficult to understand because in them there are many formulas that must be memorized. Another problem is that the practice questions given by the teacher are often not the same as the examples described. The question of the training given also had nothing to do with the expertise program they lived in so that students thought that mathematics was not important to learn.

Based on the problems found from observations at SMK 1 Koto Balingka and SMK Negeri 1 Lembah Melintang, it is necessary to improve the learning process. For this reason, the teacher is required to make a more innovative learning, namely by developing learning tools in the form of RPP and LKPD based on professional competence for grade X vocational students in mathematics learning.

Based on the description from the background above, a preliminary analysis was carried out on the development of Professional Competency-Based Mathematics Learning Tools in the Electricity Engineering Expertise Program for Class X Vocational Students. Professional competency-based mathematics learning tools in the electricity engineering expertise program will help students understand the material presented more easily because mathematics learning activities are directly related to students' skill programs.

The purpose of the preliminary analysis of the development of this mathematics learning tool is to obtain information about the problems found in schools related to mathematics learning.

2. Method

This type of research is research and development. According to Borg and Gall in Sugiyono (2011:9) "research and development (R&D) is a research method used to develop or validate products used in education and learning."
The development model used in this study is the Plomp development model. This model was developed by Tjeerd Plomp (2013:10-35) which consists of 3 stages: preliminary research, development or prototyping phase, and assessment phase. In the preliminary analysis activities only carried out preliminary research stages in the form of needs analysis, curriculum analysis, concept analysis, and analysis of students to get information about problems found in schools related to learning mathematics as a basis for determining alternative solutions and studying the range of material needed to reach indicators - indicators of achievement of competencies and product specifications needed.

Data collection techniques used in the research that will be carried out are observation sheets, questionnaires, interview guidelines, and problem solving abilities. Descriptive techniques are used to describe data from interviews.

3. Results And Discussion

Needs analysis is carried out through interviews with teachers of class X of SMK Negeri 1 Lembah Melintang. Teacher interviews contain questions about the learning process and LKPD that are used in the mathematics learning process. The results of the interview with the teacher at this stage of needs analysis obtained information that there is a need for renewal of the learning process to achieve the objectives of learning mathematics. This is because the results of interviews with teachers indicate that the lesson plans used are still general, besides that the RPP made by the teacher also has no professional competence of students. Examples of lesson plans used by teachers.

![Figure 1. Examples of RPP used by teachers during learning](image)

Curriculum analysis was carried out on the curriculum used in class X of State Vocational High School 1 Lembah Melintang and State Vocational High School 1 Koto Balingka, namely 2013 Curriculum.
Mathematics KD is associated with specialization subject matter in electricity engineering program. The results of the analysis of KI and KD are used to formulate indicators of achievement of competence. Examples of the results of curriculum analysis as follows.

| Kompetensi Inti (Penguasaan) | Kompetensi Dasar | Kompetensi Inti 4 (Keterampilan) | Kompetensi Dasar |
|------------------------------|-----------------|---------------------------------|-----------------|
| 2.1 Menyelesaikan masalah konteksual yang berkaitan dengan masalah dan data aritmetika | 1.2 Memahami tata letak komponen instalasi penerangan pada bangunan sederhana (instalasi Penerangan Listrik) | 4.2 Memahami tata letak komponen instalasi penerangan pada bangunan sederhana (instalasi Penerangan Listrik) |  |
| 2.2 Memahami macam-macam pengendali motor listrik (instalasi motor listrik) | 3.2 Memahami gambar keja (rencana) penerangan instalasi tenaga listrik satu fase (instalasi tenaga listrik) | 4.2 Memahami macam-macam pengendali motor listrik (instalasi motor listrik) |  |
| 3.2 Memahami gambar keja (rencana) penerangan instalasi tenaga listrik satu fase (instalasi tenaga listrik) |  | 4.2 Memahami macam-macam pengendali motor listrik (instalasi motor listrik) |  |
| Contoh Masalah: : Salah satu bio instalasi listrik akan memasang instalasi listrik disebelah gedung. Bio tersebut akan memasang instalasi pada f2 titik lampu dengan menggunakan sistem Tee Dos Clipsal cabang 3. Jika pada masing-masing titik lampu jumlah Tee Dos Clipsal cabang 3 yang digunakan harus mengikuti peningkatan sejumlah Tee Dos Clipsal cabang 3. Tenangkan jumlah Tee Dos Clipsal cabang 3 pada tipik terakhir jika pada tipik ke 3 dijumlahkan sebanyak 5 Tee Dos Clipsal cabang 3. |  |  |  |

**Figure 2.** Examples of Mathematics Subjects and Content Subjects of Specialization in Vocational Schools in the Electrical Engineering Expertise Program

The participant's analysis was not carried out on the characteristics of students, the ability of students in learning mathematics, and the professional competence of students. In addition, observations were also made on teacher activities, namely how teachers make learning tools, how teachers use models and strategies in learning and how LKPD is made by teachers. Examples of students' problem solving abilities.
Concept analysis is carried out by identifying the concepts, detailing and systematically arranging the material that students will learn. Example of the results of concept analysis.

| Kompetensi Dasar (KD)                          | Indikator Pencapaian Kompetensi (IPK) | Tujuan Pembelajaran | Pertemuan |
|-----------------------------------------------|--------------------------------------|---------------------|-----------|
| 3.5 Menganalisis barisan dan deret aritmetika | 3.5.1 Menentukan konsep barisan       | 3.5.1.1 Peserta didik dapat menyebutkan definisi dari barisan |
|                                               |                                      | 3.5.1.2 Peserta didik dapat menentukan pola barisan           |
|                                               |                                      | 3.5.1.3 Peserta didik dapat menentukan suku ke-n suatu barisan|

**Figure 4.** Example of the results of concept analysis

### 4. Conclusions

Preliminary analysis on the development of professional competency-based mathematics learning tools in the electrical engineering expertise program for Grade X vocational students consists of preliminary research in the form of needs analysis, curriculum analysis, concept analysis, and analysis of students to get information about the problems found in schools related to mathematics learning as the basis for determining alternative solutions and studying the range of material needed to achieve competency achievement indicators and product specifications needed.
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