A Solution to Competency Test Expertise of Engineering Motorcycles using Simple Additive Weighting Approach

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Abstract—Based on Basic Skills Competency Exam is a test of the ability of vocational students in the practice of any particular study program Motorcycle Engineering (TSM). This test is very important because it can be used in the reference that students are already eligible for the world of work or not. This is also should be supported by a practical tool that have been defined by the department of education, so that a proper assessment of the worthiness laboratorium or workshop at SMK for the implementation of Skills Competency Test with this system is expected to assist the education department in improving graduates with the facilities and decent infrastructure.

Keywords - Decision Support Systems, Repair, Skills Competency Test

I. INTRODUCTION

Vocational High School (SMK) is a secondary education that prepares students to have professional expertise, productive and independent. Students are prepared to work in a particular field and aims to produce graduates become qualified workforce and competitive era of globalization. Further described in Government Regulation No. 19 of 2005 on National Education Standards, the aim of the SMK is a priority to prepare the students to enter the workforce and develop a professional attitude [1].

To produce graduates with international competitiveness, the school should be able to prepare their students based on the National Education Standards (NES). NES is the minimum size of the education system throughout the territory of the Republic of Indonesia. But this must be accompanied by a laboratory or workshop facilities that meet national educational standards.

The previous study conducted by the Wahyu Hendra Setiawan Yogyakarta University students in (2016) with the title of the Feasibility Study Infrastructures Practice Vocational Competency Exam Light Vehicle Engineering Program accredited private vocational Sleman. In a study conducted by Hendra using quantitative descriptive method by taking samples 3 SMK and obtains the average percentage of the three schools of 58.33% and entered in decent condition based infrastructure standards that have been set by ministerial regulation education department (Permendiknas) No. 40 in 2008. For the practical means of electrical engineering skills program SMK Negeri light vehicles Sleman obtain a percentage of the average of the three vocational amounted to 60.47% and in the category of eligible based Permendiknas 40 in 2008 and Verification Instrument vocational competency exam expertise organizers of National Education Standards [2].

There are some majors program at SMK expertise include Computer Network, Light Vehicle Engineering, Audio Visual and Motorcycle Engineering (TSM). All courses require infrastructure and facilities must meet national standards to produce quality graduates. This should be accompanied laboratories / workshops that meet the standards of practice UKK (Skills Competency Test) at SMK.

II. THEORITICAL

A. Decision Support Systems (DSS)

Bozczek (2010:13) a decision support system is a computer based system consisting of components among other components of the system language (language), the system components of knowledge (knowledge) and system components processing problems [3].

Raymon McLoed, Jr. in a Turban (2011:2) decision support system is a system that provides the ability to problem-solving and communication for the issues that are semi-structured [4].

B. Vocational High School

Vocational High School, hereinafter abbreviated as CMS, is one form of formal education unit which organizes
vocational education in secondary education as a continuation of the SMP, MTs, or other form of equal or advanced on the learning outcomes that are recognized the same or equivalent junior high school or junior (Government Regulation, 2010: 5) [5].

According to the explanation written in Law Number 20 Year 2003 on National Education System Article 15 explained that "Vocational education is secondary education that prepares students primarily to work in a specific field [6].

C. Motorcycle Engineering

Eligibility engineering motorcycle at SMK aims to equip students with the skills, knowledge and attitudes to be competent in carrying out the maintenance and repair of the components of a motorbike independently, maintain and repair the motorcycle in accordance with the standards specified by the manufacturer, maintain and repair bicycles motorcycle in the garage or company where the working place, creating new job opportunities for others [7].

Motorcycle repair services to the community aims to provide good service to the community and highlight the advantages of motorcycle engineering students mainly maintain and repair motorcycles [8].

D. Skills Competency Test (UKK)

Vocational Skills Competency Test on a part of the National Examination which is an indicator of achievement of competency standards, while the stakeholders will serve as information on the competency of the candidates. In the academic year 2014/2015 National Examination for students of SMK stipulated in the Regulation of the Minister of Education and Culture of the Republic of Indonesia (RI Permendikbud) Number 59 Year 2011 regarding Criteria Graduation of Students of the Education Unit and the Implementation of the Examination Schools and the National Examination.

The practical examination is an integral part of the activities of the national exam which must be followed by class XII student in completing the final task of the series of learning activities. This is important because students can be observed and evaluated the extent to which have achieved the standard of competence achieved in the level of vocational school level and become a measure of whether the skills of the students are already considered capable of performing certain skills or not [9].

E. Laboratory or workshop

Laboratory or workshop is a place to carry out the practical lesson that requires special equipment. Laboratory or workshop serves as a place to solve problems, explore a fact, coaching ability, skills, and develop an attitude [5].

According Permenpan No. 3 In 2010 the Laboratory or workshop is a unit Academic support in educational institutions, in the form of a closed room or open, permanent or mobile, managed systematically to activities of testing, calibration, and / or production on a limited scale, with the use of equipment and materials by the scientific method specified, for the implementation of education, research, and / or community service [6].

III. RESEARCH METHODS

A. Simple Additive weighting method

SAW is a weighted summation method. The basic concept is to find a method of SAW weighted summation of branch performance at each alternative on all criteria (Kusumadewi, 2013). This method requires a process of normalization SAW decision matrix (X) to a scale that can be compared with all branches of existing alternatives. SAW method to know their two attributes that criterion advantages (benefits) and cost criteria (Cost). The fundamental differences of both of these criteria are in the selection criteria when making decisions [13][14].

Here is the formula of simple additive weighting method (SAW):

\[
rij = \frac{\text{Max}(xij)}{\text{Min}(xij)} \times (\text{benefit}) \frac{\text{Benefit}}{\text{Cost}} \text{ ... (1)}
\]

Where:

- Rij = value normalized performance rating
- Xij = the attribute value of each criterion is owned
- Maxxij = largest value of each criterion
- Minxij = smallest value of each criterion
- Benefit = If the greatest value is the best
- Cost = If the smallest value is best

With rij is the normalized performance rating of Ai on attribute Cj; i = 1,2, ..., m and j = 1,2 ... n

Preference value for each alternative (Vi) is given as:

\[
V_i = \sum_{j=1}^{n} W_j \times rij
\]

......................... (2)

Vi = Ranking of alternative
Wj = Weight value of criteria
rij = normalized performance rating

The steps in the completion of use are:

1. Determining the alternative, that Ci
2. Determine the suitability rating each alternative on each criterion.
3. Provide rating matches the value of each alternative on each criterion.
4. Determine the weight of preference or level of interest (W) each criterion, W = [W1, W2, W3, Wh]
5. Create a table rating the suitability of each alternative on each criterion.
B. Worthiness Analysis Laboratory or Workshop

The scale of measurement is an agreement that is used as a reference for determining the length of the short interval in the measuring tool, so that the instruments used in the measurements will produce quantitative data [10]. In this study the scale used is the Rating Scale (a graduated scale). Rating Scale itself is a measurement scale in which the raw data obtained in the form of numbers and then interpreted in a quantitative sense. The most important data obtained in the form of numbers and then interpreted in a quantitative sense. The most important data obtained in the form of numbers and then interpreted in a quantitative sense. The most important data obtained in the form of numbers and then interpreted in a quantitative sense. The most important data obtained in the form of numbers and then interpreted in a quantitative sense.

C. Determining Worthiness Criteria Lab/Workshop TSM

In the calculation method Simple Additive weighting of worthiness criteria, the next step determines suitability rating:

<table>
<thead>
<tr>
<th>No</th>
<th>Alternative School</th>
<th>Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>100</td>
<td>25%</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>H</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>I</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>J</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The next step determines suitability rating:

IV. Discussion

A. Weighting Criteria

In this study the worthiness of the decision-making process lab/workshop TSM for UKK using SAW method, there are several criteria, among others:

Then do the decision matrix formed from:

\[
X = \begin{pmatrix}
100 & 75 & 100 & 100 \\
75 & 100 & 75 & 100 \\
50 & 25 & 75 & 75 \\
25 & 75 & 25 & 50 \\
25 & 75 & 25 & 50 \\
75 & 50 & 50 & 75 \\
100 & 100 & 50 & 75 \\
100 & 50 & 50 & 75 \\
75 & 75 & 25 & 75
\end{pmatrix}
\]

Normalization of each alternative. The formula used as follows:

\[
R_{ij} = \frac{x_{ij}(\text{max} (X)/\text{min} (X))}{x_{ij}}
\]
Where:
If J is an attribute advantage (benefit)
If J is an attribute costs (cost)

Normalization Matrix
\[
\begin{array}{cccccc}
    r_{11} & = & \frac{1}{0.75} & = & 1 \\
    r_{12} & = & \frac{0.75}{0.75} & + & 0.25 & = & 0.75 \\
    r_{13} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{14} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{21} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{22} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{23} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{24} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{31} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{32} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{33} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{34} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{41} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{42} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{43} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{44} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{51} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{52} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{53} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{54} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{61} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{62} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{63} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{64} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{71} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{72} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{73} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{74} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{81} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{82} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{83} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{84} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{91} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{92} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{93} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{94} & = & \frac{0.75}{0.75} & = & 0.75 \\
    r_{10} & = & \frac{0.75}{0.75} & = & 0.75 \\
\end{array}
\]

From the above calculation normalization matrix obtained as follows:

\[
R = \begin{bmatrix}
    1 & 0.75 & 1 & 1 \\
    0.75 & 1 & 0.75 & 1 \\
    0.5 & 0.25 & 0.25 & 0.75 \\
    0.25 & 1 & 0.25 & 0.75 \\
    0.25 & 0.75 & 0.25 & 0.75 \\
    0.75 & 0.25 & 0.25 & 0.75 \\
    1 & 0.5 & 0.5 & 0.75 \\
    0.75 & 0.75 & 0.25 & 0.75 \\
\end{bmatrix}
\]

Assign a value to each of the following criteria:

\[W_1 = 25\%, \; W_2 = 35\%, \; W_3 = 20\%, \; W_4 = 20\%\]

Furthermore, the results of the rank or the best value for each alternative (V_t) can be calculated with the following formula:

\[V_t = \sum W_j R_{ij} \]  (4)

The result:

\[V_1 = (0.25)(1) + (0.35)(0.75) + (0.2)(1) + (0.2)(1) = 0.25 + 0.262 + 0.2 + 0.2 = 0.912\]

\[V_2 = (0.25)(0.75) + (0.35)(1) + (0.2)(0.75) + (0.2)(1) = 0.187 + 0.35 + 0.15 + 0.2 = 0.887\]

\[V_3 = (0.25)(0.5) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.125 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_4 = (0.25)(0.25) + (0.35)(0.75) + (0.2)(0.5) + (0.2)(0.5) = 0.063 + 0.263 + 0.05 + 0.1 = 0.476\]

\[V_5 = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_6 = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_7 = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_8 = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_9 = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]

\[V_{10} = (0.25)(0.75) + (0.35)(0.5) + (0.2)(0.25) + (0.2)(0.75) = 0.1875 + 0.175 + 0.05 + 0.15 = 0.5\]
Based on the above calculation of ranking the calculation results can be seen in the table below:

<table>
<thead>
<tr>
<th>School</th>
<th>Code</th>
<th>Ranking</th>
<th>Value</th>
<th>Describe</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMK YPT Pringsewu</td>
<td>A</td>
<td>I</td>
<td>0.912</td>
<td>Very Decent</td>
</tr>
<tr>
<td>SMK Yasmida Ambarawa</td>
<td>B</td>
<td>II</td>
<td>0.881</td>
<td>Very Decent</td>
</tr>
<tr>
<td>SMK Pelita Gadingrejo</td>
<td>C</td>
<td>IX</td>
<td>0.5</td>
<td>Very Decent</td>
</tr>
<tr>
<td>SMK KH. GhalibPringsewu</td>
<td>D</td>
<td>IV</td>
<td>0.613</td>
<td>Well Worth It</td>
</tr>
<tr>
<td>SMK 2 Mei Pringsewu</td>
<td>E</td>
<td>X</td>
<td>0.478</td>
<td>Less Eligible</td>
</tr>
<tr>
<td>SMK MuhammadiyahPringsewu</td>
<td>F</td>
<td>VIII</td>
<td>0.563</td>
<td>Less Eligible</td>
</tr>
<tr>
<td>SMK MuhammadiyahPagelaran</td>
<td>G</td>
<td>VII</td>
<td>0.563</td>
<td>Less Eligible</td>
</tr>
<tr>
<td>SMK PGRI 02 Pringsewu</td>
<td>H</td>
<td>III</td>
<td>0.85</td>
<td>Very Decent</td>
</tr>
<tr>
<td>SMK PGRI 01 Gumukmas</td>
<td>J</td>
<td>V</td>
<td>0.625</td>
<td>Less Eligible</td>
</tr>
<tr>
<td>SMK Karya Bhakti Pringsewu</td>
<td>J</td>
<td>VI</td>
<td>0.581</td>
<td>Less Eligible</td>
</tr>
</tbody>
</table>

Based on the table above the results obtained lab / workshop TSM less viable is at SMK May 2 Pringsewu and SMK Pelita Gadingrejo with respective values of 0.5 and 0.478.

B. Grafik Worthiness Lab/Workshop TSM SMK at District Pringsewu

From the data table concluded with the following graph:

![Grafik Worthiness Lab/Workshop TSM SMK at District Pringsewu](image_url)

Gambar 4.1. Grafik Worthiness Lab/Workshop TSM SMK at District Pringsewu

V. CONCLUSION AND SUGGESTION

A. Conclusion

The conclusion of the study is to make a decision support system worthiness lab / workshop on the implementation of the UKK results obtained lab / workshop TSM less worthy is at SMK May 2 Pringsewu and SMK Pelita Gadingrejo with respective values of 0.5 and 0.478.

B. Suggestion

After the development of the current system into the new system and after seeing the results of the research conducted, the writer put forward some suggestions that are expected to be taken into consideration. The suggestions are:

a. Simple Additive weighting method (SAW) is expected to be implemented into the software better or add another method to get a more accurate result.

b. The replacement of the old system to the new system and it takes time for adjustment in implementing the changes to the old system. Replacement of the system is done gradually.

References


