Developing The Standard Competencies For Vocational Teacher Candidates Of Mechanical Engineering

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Abstract. This study aimed to: (1) obtain an overview of the current competency profiles of vocational teacher candidates of mechanical engineering, (2) gain an overview of the obstacles faced by vocational teachers of mechanical engineering in their competency completion, and (3) obtain the ideal formulation of the standard competencies for vocational teacher candidates of mechanical engineering. This research is of research and development (R&D) type. The sample was 32 vocational high school teachers of machining major and six relevant industrial practitioners from Yogyakarta Special Region. Data collection technique used questionnaires. Data analysis used descriptive statistical analysis techniques. Results of this study were: (1) the current competence of vocational teacher candidates of mechanical engineering was in the good category with a mean of 3.94; (2) there were seven obstacles faced by vocational teachers of mechanical engineering on their competencies completion, namely professionalism, motivation, facilities, workload, government policy, adaptability, and self-development; and (3) the ideal formulation of the standard competencies for vocational teacher candidates of mechanical engineering can generally be classified into pedagogical competence, competence in the field of expertise, managerial competence, personal competence, and social competence.

1. Introduction

Vocational education as the frontline in preparing human resources in the industrial sector should be able to prepare skilled labor to work in industries according to the fields of expertise. Moreover, in this era of Industrial Revolution 4.0, digitalization and automation became an inseparable part of the production process. If the labor graduated from vocational education in Indonesia is unable to meet with the technological development, and then there will increase the number of unemployment due to the increasing of experts from abroad. And some types of work have been replaced by robots that have the ability of artificial intelligence.

Data from the Central Statistics Agency (BPS, 2017) of the Indonesian labor by August 2017 stated that in the last one year, unemployment increased by 10,000 people, while the Open Unemployment Rate (TPT) decreased by 0.11 points. According to data, viewed on the level of education, then the TPT for Vocational High Schools is the highest among other education levels, which is 11.41%. The investment of human resources must be optimized aiming to anticipate the unemployment contribution from the vocational education sector from getting higher. On this side, vocational education can take a role, by building a quality education.

Soeprijanto (2010) stated that aiming to build a quality education; it needs to perform comprehensively including the teacher availability, the availability of facilities and infrastructure, as well as the curriculum and learning system. However, the rapid development of industry, especially the application of the latest technology, is often not followed by vocational education as a "provider"
of human resources in the sector. So, most vocational education graduates are still ready to train, but they are not yet ready for work. One of the main factors is because not all educators (teachers, instructors) are able to update knowledge and the latest skills. As a result, the initiated learning was also not developed. Therefore, providing a quality teacher is an important aspect and needs to be a priority as an effort to build a quality education.

The current government policy encourages the vocational education to be the spearhead of national progress and independence that must be momentum to improve the quality of vocational education. A realization of this policy is the tendency to increase the number of vocational schools than the public schools. The logical consequence of this policy is that the efforts must provide the procure sufficient and quality vocational teachers, preparation of the latest learning facilities and infrastructure, and the opening of new study programs in accordance with industrial developments.

A qualified vocational teacher candidate is reflected on the possessing of qualified knowledge and skills, and the ability to follow the development of the latest schooling systems such as curriculum changes, teaching materials changes, up-to-date learning media, and other matters relating to teacher duty. The current issue, especially regarding the 4.0 industrial revolution, also has an impact on the needed abilities or qualifications of teachers. Meanwhile, the guideline for developing the curriculum of the Educational Personnel Education Institution (LPTK) (Supriadi Rustad, 2013) stated that the formulation of teacher competencies in Law No. 14 of 2005 still considers as fragmentary and might not be used directly as a basis for preparing the teacher education program curriculum.

Based on the description, it would be very urgent to reformulate and affirm the integrity of the competence of vocational teacher candidates. The competence of vocational teacher candidates must follow the determined qualifications to deal with the development of science, technology, and growth in the industrial sector which has increased rapidly lately. The competency formula for vocational teacher candidates is hopefully, in the future, to be a material for the assessment and development of education curricula of vocational teacher candidate based on in-depth need assessment. Because it related to the complex competence of vocational teacher candidates, so this study is limited to the development of competency standards for vocational teacher candidates on mechanical engineering, especially on their professional abilities.

2. Method

This research type was quantitative research with survey methods. This research conducted from February to July 2018. And, it conducted in the Special Region of Yogyakarta.

The population of the study was vocational engineering teachers and industrial practitioners. And the sample was 32 teachers of mechanical engineering of vocational school and 6 relevant industry practitioners from the Special Region of Yogyakarta. The detailed information was presented in table 1 and table 2.

| No. | Experiences | Position                                           |
|-----|-------------|----------------------------------------------------|
| 1.  | 30 years    | Teacher of Machining Production                    |
| 2.  | 31 years    | Teacher of Machining Production                    |
| 3.  | 25 years    | Teacher of Machining Production                    |
| 4.  | 30 years    | Head of Machining Technique & Teacher of Machining Production |
| 5.  | 17 years    | Teacher of Machining Production                    |
| 6.  | 19 years    | Teacher of CNC Production & Welding                |
Table 2. Respondent of Industry Practitioners

| No. | Work Experience | Position                                      |
|-----|-----------------|-----------------------------------------------|
| 1   | 6 years         | Head of Manufacture Division                  |
| 2   | 35 years        | Deputy Director                               |
| 3   | 18 years        | Operational Manager of Mold Making            |
| 4   | 16 years        | Head of Production                            |
| 5   | 10 years        | Head of CNC Mill division                     |
| 6   | 25 years        | Manager                                       |

The selection of DIY was because it adjusted the location of the researcher and the suitability of the characteristics of the vocational education. Random sampling was used to select the samples.

Data collection technique was documentation and questionnaires. The data analysis of questionnaire used descriptive statistical analysis.
Table 3. Categories of Theoretical Assessment

| Interval                           | Category       |
|------------------------------------|----------------|
| $\bar{M}_i + 1,8 SD_i < X \leq \bar{M}_i + 3SD_i$ | Very Good      |
| $\bar{M}_i + 0,6 SD_i < X \leq \bar{M}_i + 1,8 SD_i$ | Good           |
| $\bar{M}_i - 0,6 SD_i < X \leq \bar{M}_i + 0,6 SD_i$ | Less Good      |
| $\bar{M}_i - 1,8 SD_i < X \leq \bar{M}_i - 0,6 SD_i$ | Poor           |
| $\bar{M}_i - 3SD_i \leq X \leq \bar{M}_i - 1,8 SD_i$ | Very Poor      |

Where:

$\bar{M}_i$ = Mean of ideal = $\frac{1}{2}$ (highest score + lowest score)

$SD_i$ = Standard Deviation of ideal = $\frac{1}{6}$ (highest score – lowest score)

$X$ = Actual Score

Highest Score = alternative score of highest answer (5)

Lowest Score = alternative score of lowest answer (1)

According to the previous information, the criteria for data interpretation are presented in Table 2.

Table 4. Criteria of Data Interpretation

| Interval | Category |
|----------|----------|
| 4,2 < X ≤ 5 | Very Good |
| 3,4 < X ≤ 4,2 | Good |
| 2,6 < X ≤ 3,4 | Less Good |
| 1,8 < X ≤ 2,6 | Poor |
| 1 ≤ X ≤ 1,8 | Very Poor |

3. Result and Discussion

3.1 Profile of Competency of Vocational Teacher Candidate of Mechanical Engineering

Profile of Competency of Vocational Teacher Candidate in this study includes 5 competencies, namely pedagogic competence, competency in field of expertise, managerial competence, personality competence, and social competence. Data from the research results are presented in Table 5.

Table 5. Profile of Competency of Vocational Teacher Candidate of Mechanical Engineering According to Vocational Teacher Opinions

| No. | Competence          | Mean | Interpretation |
|-----|---------------------|------|----------------|
| 1.  | Pedagogic           | 3,88 | Good           |
| 2.  | Field of expertise  | 4,00 | Good           |
| 3.  | Managerial          | 3,84 | Good           |
| 4.  | Personality         | 4,13 | Good           |
| 5.  | Social              | 3,83 | Good           |
|     | Total               | 3,94 | Good           |

Based on Table 5, generally, the competencies of vocational teacher candidates of mechanical engineering is on good categories. The best of mean sequences are (1) personality competencies, (2) competencies in the field of expertise, (3) pedagogical competencies, (4) managerial competencies, (5) social competencies.
and (5) social competencies. More detailed comments or explanations from respondents on their competency assessment of teacher candidates are presented in Table 6.

**Table 6. Vocational Teacher’s Comments on Mastery of Vocational Teacher Candidates of Mechanical Engineering**

| No. | Competency       | Comments                                                                 |
|-----|------------------|--------------------------------------------------------------------------|
| 1.  | Pedagogic        | • Teaching Preparation is very good                                    |
|     |                  | • Learning media is good                                                |
|     |                  | • Class mastery is good                                                 |
|     |                  | • Using learning media                                                  |
|     |                  | • The student is enthusiastic about following the learning              |
|     |                  | • Need a learning variation in the class                                |
|     |                  | • Learning media is less of communicative                               |
|     |                  | • Class mastery need to increase with experience                        |
|     |                  | • Need an increasing on the ability to use the learning model according to the characteristic of a subject |
|     |                  | • The ability of presentation needs to improve                          |
|     |                  | • Time management during learning need to improve                       |
|     |                  | • The references/ source of learning is minimum                          |
| 2.  | Field of Expertise| • Material mastery of the update or modern                              |
|     |                  | • Material mastery in theory and practice                                |
|     |                  | • Able to provide appropriate example during the learning practice (demonstration) |
|     |                  | • Tend to choose teaching practice in basic class (class X)             |
|     |                  | • Need to support with a competency certificate                          |
|     |                  | • Need a self-preparation to mastery “all” the subject on mechanical engineering, not only choose an option (concentration) of the study |
| 3.  | Managerial       | • Coordination between fellow and teacher (tutor) in the school on good.|
|     |                  | • Cohesive and organized teaching with other fellows                     |
|     |                  | • Less of mastery the TUSO or assignment on organizational structure      |
| 4.  | Personality      | • Good Looking                                                           |
|     |                  | • On time                                                                |
|     |                  | • Be an example for students                                             |
|     |                  | • Polite                                                                 |
|     |                  | • Courtesy                                                               |
|     |                  | • Appreciate the teacher’s suggestion                                    |
|     |                  | • Un-self confident                                                      |
|     |                  | • Some of them are not on time with the time allocation                  |
|     |                  | • Some students need to consider the dress style, aiming to differentiate when becoming a students and teacher on position |
|     |                  | • The appearance of a teacher must appear since they conduct observation |
|     |                  | • Full of responsible to duty                                             |
|     |                  | • Often speak slang (taboo word) with friends                            |
|     |                  | • Have a good 5S                                                          |
| 5.  | Social           | • Have a good interaction with others                                    |
|     |                  | • Able to blend with all the school’s element                            |
|     |                  | • Some students only make good communication with the tutor              |
Based on Table 5, the mean of competency achievement of vocational teacher candidates of mechanical engineering which is still below 4 is pedagogic, managerial, and social competencies. The main competency of a teacher, stated by Leavold & Taylor (2009) is pedagogic competence. Therefore, the study found out that efforts need to perform aiming to improve the pedagogical abilities of teachers.

Efforts to improve the pedagogical competence might conduct in various ways or methods. Rina Febriana (2016) in the research tried to identify the components of vocational teacher pedagogical training models and successfully identified (eight) components of pedagogical training models, namely: (1) student understanding, (2) curriculum / syllabus development, (3) learning design, (4) implementation of educational and dialogical learning, (5) learning technology use, (6) student development, (7) learning evaluation, and (8) reflection. The eight components might apply to improve the pedagogical competencies of teacher candidate of vocational engineering.

Managerial competency is a need that must also be mastered by a vocational teacher of mechanical engineering based on the regulation of Minister of Education No. 39 of 2009 on Fulfillment the Teacher's Workload and Supervisor of Education Unit. The managerial competency listed in the Ministerial Regulation is that the teacher has additional duties as head, deputy head, head of the laboratory, head of the workshop, or head of the unit production of the educational unit. In addition, the teacher might also have additional assignments as the head of the study program or management at the department level. Bubb & Earley (2004) also clearly states that teachers have a workload in terms of school management. Therefore, managerial competency is a very important competency and is mastered by a teacher. So, it needs to be trained to teachers’ candidates.

Increasing the social competency of teacher candidate is one of the important things. Teachers in performing daily activities will definitely involve in interaction with many people, or, at least, interaction among students, fellow teachers, parents/guardians of students, education staff, and the surrounding community. Mastery of this competence is absolute as stated in the explanation of Article 10 Paragraph 1 of the Republic of Indonesia Law No 14 of 2005 on Teachers and Lecturers. An effort to improve the social competency are by increasing the involvement of teachers and teachers candidate to be more active in the Forum for Teacher Subjects (MGMP), professional associations, or various other forms of similar activities.

3.2 The constraint Faced by Vocational Teachers

Based on the statements from the questionnaire, might be classified into 7 (seven) aspects of the constraints faced by teachers in mastery the competencies that are in terms of: (1) professionalism, (2) motivation, (3) facilities, (4) workload, (5) government policy, (6) adaptability, and (7) self-development. The seven constraints are explained in Table 7.
| No. | Aspect            | Description of teacher’s comment                                                                                                                                 |
|-----|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                   | inappropriate                                                                                                                                               |
| 2.  | Motivation        | a. Low on learning in using information technology to support the learning                                                                                 |
|     |                   | b. Low of willing to develop and increase the competency                                                                                                   |
| 3.  | Facility          | a. Slow in tools upgraded                                                                                                                                     |
|     |                   | b. Unbalance the facility in the school with the demand of the assignment                                                                                  |
|     |                   | c. Must of practice tool are broken                                                                                                                           |
|     |                   | d. The precise of tool/machine is not good                                                                                                                     |
|     |                   | e. The limitation of practical tools                                                                                                                          |
|     |                   | f. Using a conventional tool, and out of date                                                                                                                  |
|     |                   | g. The high difference between the technology of industry and tool/technology in the school                                                                    |
| 4.  | Workload          | a. The high workload there out of teaching duty decrease the time to upgrade the competency/technology                                                     |
|     |                   | b. The high of administration and additional assignment, so the teacher less have an increasing competency                                                   |
| 5.  | Government Policy | a. The curriculum and curriculum structure are frequently changing and making it difficult for teachers to quickly adapt to the newest curricula. |
|     |                   | b. The policy of adding new subjects, such as the PKK (Creative Products and Entrepreneurship) has not been balanced with training and completes the learning resources. So, teachers must seek and learn material independently. |
| 6.  | Adaptability      | The rapid growing of IPTEK (Science and Technology) and followed by the majority of teacher                                                                 |
| 7.  | Self-Development  | a. Lack of apprenticeship, upgrading, competency development training programs, and training to increase knowledge and skills for teachers |
|     |                   | b. The teachers chosen by school leaders to attend Diklat (short training) are only the same person, So, there is no equal opportunity to participate in training for other teachers |

Based on Table 7, the highest problem experienced by the majority of schools is in terms of inadequate facilities both in terms of quantity, quality, and care. Discussing the problem of practice facilities in engineering vocational schools, Syahril Is (2012) stated that the scenario of providing practical facilities to achieve vocational competence until 2025 is to upgrade the main tools, cutting tools, complementary equipment, the supply of materials, and increase the amount of space or room.

Another interesting finding in this study was the teacher’s awareness to have competency certificates as a form of recognition of teacher qualifications. The findings suggest the policyholders, preferably providing broad and equitable opportunities for each teacher to develop themselves through Diklat (short training) activities, internships, or training activities. So, they will able to improve the competence of vocational teachers.
3.3 The Standard Competencies For Vocational Teacher Candidates of Mechanical Engineering

Based on the opinions stated by the teachers on the ideal of standard competencies for vocational teacher candidates of mechanical engineering, the data classified into 5 (five) aspects of competency. The five aspects of competency are pedagogic competence, competency in the field of expertise, managerial competence, personality competence, and social competence. The opinions of vocational school teachers are presented in Table 8.

Table 8. The Standard Competencies For Vocational Teacher Candidates of Mechanical Engineering according to vocational teacher

| No. | Competency | Description of Teacher’s Opinion |
|-----|------------|----------------------------------|
| 1.  | Pedagogic  | a. Able to prepare the learning tools  |
|     |            | b. Mastery of the learning strategy  |
|     |            | c. Mampu mendidik. Able to educate |
|     |            | d. Mastery the information technology to support the learning |
|     |            | e. Able to create a pleasant learning atmosphere |
|     |            | f. Able to make and use a learning media |
|     |            | g. Have skill of class mastery |
|     |            | h. Have presentation skills |
|     |            | i. Emphasizes on student creativity |
|     |            | j. Can deliver the knowledge to students |
|     |            | k. Able to apply bilingual learning, mastering the foreign languages (especially English) |
| 2.  | Field of the Expertise | a. Mastery of the basic theory of engineering |
|     |            | b. Mastery of both theoretical and practical material in mechanical engineering |
|     |            | c. Mastery of the knowledge and skills on productive subjects to the complex level (lathe machining, milling machining, grinding machining, and CNC) |
|     |            | d. Have the field of expertise, proven by a certificate of competence |
|     |            | e. Having competency in the field of expertise according to industry standards to prepare prospective workers |
|     |            | f. Mastery a particular field in depth (specialist) |
|     |            | g. Have experience in the field (industry) as supporting competence |
| 3.  | Managerial | Have a managerial competency, especially management of majors |
| 4.  | Personality | a. Have a strong personality |
|     |            | b. Have a tough mental |
|     |            | c. Self-confident |
|     |            | d. Noble character |
|     |            | e. Have an awareness as educator |
|     |            | f. Always perform self-development |
| 5.  | Social     | a. Able to interact with the entire school’s communities |
|     |            | b. Adaptive to technological developments |
|     |            | c. Able to provide a career understanding to students |

The five aspects of competency in Table 8, generally, have similarities with the findings of Surono and Wagiran's (2016) on the Profile of Vocational Teachers of Machining Engineering. There are 6 (six) specific competencies of new findings in this study, that vocational teachers of machining engineering should: (1) be able to apply bilingual learning, mastering foreign languages (especially English), (2) proven in the field of expertise with the certificate of competence, (3) mastery one particular field in
depth (specific), (4) have experience in the field (industry) as supporting competence, (5) have tough mental, and (6) adaptive to technological developments.

Refer to the teacher’s mastery of one specific field is in line with Celik (2011) and Milanovich cited by Harrison (1987). The findings by Celik (2011) explain that, although, much attention has been given to find out the nature of teaching and the good quality of teachers; it little emphasis on specific characteristics and competencies that must be possessed. Meanwhile, Milanovich’s opinion cited by Harrison (1987) formulates that aiming to be an effective vocational teacher must have knowledge and or experience in four things, namely: (1) ability in a specific field; (2) learning planning, implementation, and evaluation; (3) classroom and laboratory management; and (4) work experience. This formulation generally emphasizes on mastery competencies of pedagogical, managerial, and in the fields of expertise by vocational teachers.

Aiming the teachers have tough mental, as Malm (2009) argues, teacher training programs need to be focused on debriefing on mastery of conflict, self-awareness, empathy, leadership and collaborative skills. The training program also needs to consider, not only the cognitive aspects but also the social and emotional aspects of human development.

4. Conclusion and Suggestion

The conclusions of the research are, 1) The competency of vocational teacher candidates of mechanical engineering is in a good category with a mean of 3.94; 2) There are seven aspects of the constraints faced by vocational teachers of machining techniques to master the competencies, namely in terms of professionalism, motivation, facilities, workload, government policy, adaptability, and self-development; 3) The ideal competency standard of vocational teacher candidates of mechanical engineering can be classified into 5 (five), namely pedagogical competencies, competencies in the field of expertise, managerial competence, personality competence, and social competence.

This particular research still limited to survey research of a multi-year research plan to develop the competency standards for vocational teacher candidates of mechanical engineering through the research and development (R & D) method. Therefore, the standard competence presented in this report is still limited to the teachers’ opinions as respondents. The research suggests that it needs to organize a focus group discussion and inviting experts and other related parties.

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