The relevance of machining practices competencies through industrial needs

P Paryanto, S Munadi, Wagiran, E Purnomo, A Ardiyanto, E D Rahmawati
Department of Mechanical Engineering Education, Universitas Negeri Yogyakarta, Indonesia
E-mail: paryanto@uny.ac.id

This study aims to reveal the relevance of practical competencies in mechanical engineering vocational schools to the industry's competencies in the Yogyakarta Special Region. This research is a quantitative descriptive study using survey research methods with five research subjects representing the manufacturing industry. The results of this study are, in general, the competence of learning machining practices at Mechanical Engineering Vocational Schools is very relevant to the manufacturing industry's needs. Details of competency relevance data for each practical subject are as follows: (1) competency in lathe machining 42.10% relevant and 57.90% highly relevant; (2) competence of 40.90% milling machining is relevant and 59.10% highly relevant; (3) competence in grinding 33.33% relevant and 66.67% very relevant; (4) numerical control/computer numerical control and computer aided manufacturing competences 2.90% relevant and 97.10% highly relevant.

1. Introduction

Vocational High School (VHS) is a formal education that has been regulated by law in preparing human resources (HR) who are ready to enter the world of work to become a productive workforce [1]. There have been many government efforts in preparing human resources ready to enter the world of work; one of the government efforts is to build more VHS. VHS aims to prepare an independent and work-ready generation where learning at VHS students is provided with knowledge and skills so that later VHS graduates can work in industry or open their jobs [2].

One of the government's objectives is to plan a program to increase the number of VHSs, one of which is to create more VHS graduates who can be directly absorbed by the world of work as workers[3]. This objective has been stated in law No.20 on the National Education System, which explains that vocational education prepares students, especially to work in specific fields. This law can undoubtedly serve as a guide where the existence of VHS is a vocational education that produces graduates who are ready to work. The planning to increase the number of VHSs also shows that the government has very high confidence in vocational education so that it can play a very strategic role so that the realization of a skilled national workforce. VHS graduates are expected to become ready-to-use human resources because when students have finished school, they can apply the knowledge learned in work according to their competence. The learning process's success is mostly determined by educators, students, and learning resources [4].

Apart from increasing the school's interest, the government has also changed the curriculum several times. Where the curriculum replacement is intended to be closer to or harmonize with industry needs. However, although the VHS curriculum has been updated several times to suit the industry's needs, in
reality, it is always lagging behind the world of work [5]. This may occur because there are weaknesses of VHS graduates. The weakness of vocational education is that placing its graduates requires expensive investment and administration costs [6]. Also, learning at VHS is too primary in learning, as an example in discussing the technology used in computer numerical control (CNC) machines, where some schools are only facilitated by TU 2A and 3A CNC machines with simple job sheets [7]. As a result, VHS graduates find it challenging to work on complex workpieces in the industry [8]. This is in line with the statement that facilities in implementing vocational practices are vital and affect practical lessons [9].

The main challenge for Indonesian workers is the incompatibility of the education system with industrial needs, for that the link and math system is beneficial so that VHS graduates can work by industry needs. With the industry's need for labour, it is necessary to pay attention to human resources' quality following the industry. One of the qualities that need to be considered to support human resources is the quality of VHS competencies equipped for graduates to suit industry needs so that the available human resources are by the industry's quality. The concept of learning in vocational high schools should be adapted to the needs of the industry. The delivery of these is some of the problems in the world of education to learning during school. Therefore, solving these problems is needed, where problems that arise in learning require serious efforts in handling them so that quality learning can be achieved [9].

Machining engineering is one of the skills competencies in VHS. Graduates from Mechanical Engineering are more directed to work in the manufacturing industry, machinery industry, and machining enterprise, but many Mechanical Engineering graduates can be absorbed in various work fields. Of the many jobs that can be undertaken by graduates of Mechanical Engineering, it should be able to reduce the unemployment rate for VHS graduates and improve the quality of human resource work in Indonesia. However, due to the lack of adjustment to learning in schools, especially practical learning for jobs graduates will face, graduates have not met the industry's competency standards. Learning in VHS, which is very influential in meeting the industry's competency standards, is practical learning [10].

The practice carried out in VHS, especially mechanical engineering competency, is an introduction to students' knowledge and habituation to learn, explore, and apply what they want to become something that is needed [11]. The order of work in working on the given job sheet includes several competencies that students must achieve. Students have indirectly carried out competence. Therefore, the competencies that are carried out and achieved by students at VHS should be relevant to the industry's competencies.

Based on the description above, it is necessary to research the relevance of practical learning competencies in mechanical engineering Vocational Schools to the needs of the manufacturing industry in Yogyakarta. This study's focus is to reveal the extent of the relevance of the competency level of the Mechanical Engineering Vocational Schools to industrial needs based on the values obtained through calculations.

2. Method

This research is a descriptive quantitative survey method. This research emphasizes more on data collection, then describes the actual conditions that occur in the field. This research was conducted in 5 manufacturing industries in DIY, namely PT. Delta Presisi Industri, PT. Hari Mukti Teknik, CV. Karya Hidup Sentosa, CV. Rumah Mesin, and CV. Hendriansyah Racing Product. Data collection techniques using a questionnaire (questionnaire) and documentation. The data were analysed using a quantitative descriptive technique. To describe or obtain data, the research was carried out using descriptive statistical tests. In identifying the standard ideal mean (Mi) and ideal deviation standard (SDi) were used [10].
Table 1. Competency assessment categories

| Percentage Level | Categories       |
|------------------|------------------|
| \( x > M_i + 1.5 \text{SD}_i \) | Very Relevant    |
| \( M_i \leq x \leq M_i + 1.5 \text{SD}_i \) | Relevant         |
| \( M_i - 1.5 \text{SD}_i \leq x < M_i \) | Enough           |
| \( x < M_i - 1.5 \text{SD}_i \) | Irrelevant       |

3. Results and Discussions

Based on the VHS curriculum, there are 19 competency groups for learning machining practices. The results of the calculation of the average percentage of competence are presented in table 2.

Table 2. Average percentage of competence required by manufacturing industry in Yogyakarta

| Competencies                                                                 | Average of percentage |
|------------------------------------------------------------------------------|-----------------------|
| Basic understanding of lathes                                               | 92.5%                 |
| Basic use of a lathe                                                        | 80%                   |
| The use of a lathe in the manufacture of workpieces                         | 80%                   |
| Basic understanding of milling machine                                      | 95%                   |
| Basic use of a milling machine                                              | 95%                   |
| The use of a milling machine in the manufacture of workpieces               | 78.75%                |
| The use of flat grinding machines                                           | 90%                   |
| Use of cylindrical grinding machines                                        | 79%                   |
| CNC base material                                                           | 96.67%                |
| Create simple objects with CNC                                              | 82.5%                 |
| Fixed CNC settings and parameters                                           | 95%                   |
| Basic understanding of CAM CNC lathe                                        | 95%                   |
| Use of CAM CNC lathe software commands                                      | 94.2%                 |
| Use of G code CAM CNC lathe                                                 | 93.3%                 |
| Program execution to a CNC lathe                                            | 95%                   |
| Basic understanding of CAM CNC milling                                      | 95%                   |
| Using CAM CNC milling software commands                                     | 98%                   |
| Using G code CAM CNC milling                                                | 100%                  |
| Execute the program to the CNC milling                                      | 100%                  |

After knowing the percentage of competency groups needed by the industry, the level of relevance to industry needs for each practical subject is determined. The calculation results are presented in table 3 – 6.

Table 3. The relevance of practical learning competencies of lathe machining

| Relevance Level   | Number of Grains | Percentage |
|-------------------|------------------|------------|
| Very Relevant     | 11               | 57.9%      |
| Relevant          | 8                | 42.1%      |
| Enough            | 0                | 0          |
| Irrelevant        | 0                | 0          |
| Sum               | 19               | 100%       |

Table 4. The relevance of learning competencies for milling machining practices

| Relevance Level   | Number of Grains | Percentage |
|-------------------|------------------|------------|
| Very Relevant     | 13               | 59%        |
| Relevant          | 9                | 41%        |
| Enough            | 0                | 0          |
| Irrelevant        | 0                | 0          |
| Sum               | 22               | 100%       |
Table 5. The relevance of Learning Practices for Grinding Machining Practices

| Relevance Level | Number of Grains | Percentage |
|-----------------|------------------|------------|
| Very Relevant   | 6                | 66.67%     |
| Relevant        | 3                | 33.33%     |
| Enough          | 0                | 0          |
| Irrelevant      | 0                | 0          |
| Sum             | 9                | 100%       |

Table 6. The relevance of NC / CNC and CAM Machining Practices Learning Competencies

| Relevance Level | Number of Grains | Percentage |
|-----------------|------------------|------------|
| Very Relevant   | 33               | 97.1%      |
| Relevant        | 1                | 2.9%       |
| Enough          | 0                | 0          |
| Irrelevant      | 0                | 0          |
| Sum             | 34               | 100%       |

These results indicate that the overall competency in learning mechanical engineering Vocational High School is highly relevant to industry needs. Based on the results of each practical learning subject, where there are 84 questions, it is known that the results of 63 (75%) competencies fall into the very relevant category, and as many as 21 (25%) are included in the relevant category. Based on these data, it can be seen that the competence in practical learning of Mechanical Engineering Vocational Schools is relevant to industrial needs. This is very logical, where vocational education must be carried out according to the needs of the industrial world because the purpose of the world of vocational education is to prepare someone to work in a specific job group [12], [13].

4. Conclusion

Based on the results obtained, the following conclusions can be drawn, in general, practical learning competencies in machining engineering Vocational Schools are very relevant to the needs of the manufacturing industry in the Special Region of Yogyakarta. In detail, they are (1) competency in lathe machining 42.10% relevant and 57.90% very relevant; (2) competence of 40.90% of milling machine is relevant, and 59.10% is very relevant; (3) competence in grinding 33.33% relevant and 66.67% very relevant; (4) NC / CNC and CAM machining competencies 2.90% relevant and 97.10% highly relevant.

5. Acknowledgment

The author would like to thank the UNY for providing funding. Also to several manufacturing industries as the subject of this research.

References

[1] Slamet PH, "Pengembangan SMK Model untuk Masa Depan," *J. Cakrawala Pendidik.*, vol. 32, no. 1, pp. 14–26, 2013.
[2] W. Wagiran, P. Pardjono, W. Suyanto, and H. Sofyan, "Vocational Education Development Framework in 21 st Century," in *1st International Conference on Technology and Vocational Teachers (ICTVT 2017) Vocational*, 2017, vol. 102, no. Ictvt, pp. 395–398.
[3] D. Atmono and M. Rahmatullah, "The Needs Analysis of Vocational High School (VHS) in Banjarmasin Based On," *IJABER*, vol. 14, no. 13, pp. 8915–8930, 2016.
[4] S. D. Phillips, D. L. Blustein, K. Jobin-Davis, and S. F. White, "Preparation for the school-to-work transition: The views of high school students," *J. Vocat. Behav.*, 2002.
D. Ratnawati, S. Hadi, S. Setuju, B. R. Setiadi, S. Purnomo, and N. A. Handoyono, "Retooling Practice Learning Model Based on Project Based Learning Integrated to Tamansiswa Studies at University," *Int. J. Recent Technol. Eng.*, vol. 8, no. 1C2, pp. 754–758, 2019.

T. A. Sutikno, "Cooperation between vocational high schools (VHS) and industry to increase the number of hired graduates: Multi-case study on three VHSS," *Glob. J. Eng. Educ.*, vol. 16, no. 3, pp. 141–145, 2014.

Sutopo, B. R. Setiadi, and M. Hanzla, "Upgrading manual turning machine towards IoT-based manufacturing," *J. Pendidik. Teknol. dan Kejuru.*, vol. 26, no. 2, pp. 155–161, 2020.

D. Rahdiyanta, Y. Anggoro, B. S. Wijanarka, and B. T. Sasongko, "The development of interactive learning media by manufacturing helical gear using a milling machine," *J. Phys. Conf. Ser.*, vol. 1446, no. 1, 2020.

Paryanto, F. Hidayat, and C. T. Harjanto, "Implementation of problem-based learning to improve student learning achievement in turning machining lesson," *J. Phys. Conf. Ser.*, vol. 1446, no. 1, 2020.

Samidjo, Suparmin, Setuju, and B. R. Setiadi, "The phenomenon of vocational school graduates as contract labor: Start recruitment until the contract expires," *J. Adv. Res. Dyn. Control Syst.*, vol. 11, no. 11 Special Issue, pp. 998–1001, 2019.

A. Ardian, A. R. Irwantoro, and B. T. Sasongko, "Development of the maintenance and repair module for mechanical engineering education courses," *J. Phys. Conf. Ser.*, vol. 1446, no. 1, 2020.

Slamet PH, "Peranan Pendidikan Vokasional Dalam Pembangunan Ekonomi," *Cakrawala Pendidikan; No 2 Cakrawala Pendidik. Mei, 2011, Th. Xxxx, Ed. Khusus Dies Natalis*, pp. 189–203, 2009.

T. C. Ogbuanya and V. Education, "Technical, Vocational Education and Training (TVET) and the Challenges of Youth Employment for Global Workplace," *J. Educ. Rev.*, vol. 5, no. 4, pp. 543–552, 2012.