JISE 8 (2) 2019 : 215 - 220

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

Analysis of the Automotive Practice Ability in Terms of Understanding the Physics Students of Vocational High School

Nihla Nurul Laili[1]✉, Ngurah Made Darma Putra[2], Budi Astuti[2]

[1.] SMK Muhammadiyah Kajen Pekalongan, Indonesia
[2.] Universitas Negeri Semarang, Indonesia

Article Info

Article History:
Received June 2019
Accepted July 2019
Published August 2019

Keywords: Automotive Engineering, Practical Ability, Understanding of Physics.

Abstract

Physics has become the foundation of vocational competence of vocational high school or Sekolah Menengah Kejuruan (SMK) in technology and engineering expertise. This research aimed to find out the ability of automotive practice in terms of the understanding of physics students SMK skills competency in Light Vehicle Engineering or Teknik Kendaraan Ringan (TKR). This study was a qualitative research with the subjects of this research were students grade X of TKR class at three SMK in Pekalongan. The data were collected by conducting the library research, test, interviews, and documentation. The data obtained were analyzed qualitatively descriptive. The results of library research analysis on the physics basic competence of SMK curriculum 2013 with the TKR basic competence show thirteen relevant physics material and one physics material not relevant to the basic competencies of TKR. Physics material that is irrelevant is straight and circular motion. The results of the physics tests of students in three SMK are still low, while the value of students' automotive practices is in the good category. This shows that students' physical abilities have not become the basis for learning automotive practices.

✉ Alamat korespondensi:
Jl. Pahlawan, Kec. Kajen, Kebon Agung, Kajen, Subak, Kb. Agung, Kajen, Pekalongan, Jawa Tengah 51161
E-mail: nihlanurul@gmail.com

p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

The world is experiencing the fourth era of industrial revolution or industry 4.0 (Harto, 2018). The fourth industrial revolution has technological characteristics that blend with society and the human body, robotics, quantum computing, vehicle automation, virtual and physical systems in collaboration globally (Zhong et al., 2017). The progress of science in the field of technology will reduce humans as labor. The education sector, especially Vocational High School (SMK), is the main foundation for preparing a high quality and competitive workforce. Therefore, learning in SMK must emphasize students' thinking skills rather than just teaching routine skills (Luthvitasari et al., 2012).

Physics is included in the group of adaptive subjects or vocational basis in SMK. Physics subjects are used to equip students with basic knowledge of natural laws and become a condition of ability to achieve expertise program competencies (Saolika et al., 2012). Through the basic knowledge of physics that students have, it is expected that automotive vocational skills are not just trial and error. According to Wheelahan (2015) it is not just the skills needed by vocational school students, but knowledge is also needed to become the basis for applying these skills.

The relevance of physics learning with automotive is very necessary to see the extent of the picture of the relationship between competencies, because in the curriculum there must be relevance between the curriculum components. The achievement of the goal of vocational education is one of the factors that is the relevance of the competency of the lesson with the quality needs of graduates. The principle of external relevance is the suitability of the curriculum with the demands and needs of the community, while the principle of internal relevance is conformity between the curriculum itself (Ibrahim et al., 2011). Research on external relevance has been carried out, among others, the results of the Jatmoko study (2013) show the relevance of SMK curriculum competency TKR expertise on the needs of the industrial world in Sleman. In addition, the results of the study of Maulana & Winanti (2016) show that the basic competencies contained in the building drawing grade XI SMK in building drawing engineering 38.89% are relevant to the work requirements in the office of the consultant planner.

Research on internal relevance in the SMK curriculum has not been done much. Whereas internal relevance helps SMK teachers in giving special emphasis to materials that have relevance to the vocational field. Therefore, this study aims to find out the ability of automotive practice in terms of the understanding of physics students SMK skills competency in Light Vehicle Engineering or Teknik Kendaraan Ringan (TKR).

METHODS

The research used qualitative descriptive method. The research was carried out on three SMK in Pekalongan, among others SMK Negeri 1 Kedungwuni, SMK Muhammadiyah Kajen, and SMK Muhammadiyah Bligo. The research subjects were three physics teachers, three automotive teachers, and 99 students of grade X TKR. Techniques of data collection using library research techniques, tests, interviews, and documentation. The library research technique is carried out to identify the relevance of vocational physics curriculum documents and TKR subjects. Written test techniques in the form of physics questions in the form of reasoned multiple choice. The results of written tests were strengthened by interviews to explore the level of understanding of students' physics. Then the analysis of the physics test results and the document values of automotive practices were carried out to determine the relevance of physics capabilities to the automotive abilities of students.

RESULTS AND DISCUSSION

At SMK majoring in TKR, physics is included in the C1 group, namely the basic group of expertise. The TKR group was grouped into two, namely C2 as the basic group of expertise programs and C3 as the expertise competency group. In the basic skill group there are two subjects, namely, basic automotive technology and basic automotive jobs, while in the expertise competency group there are three subjects, namely maintenance of light vehicle engines, maintenance of chassis and transfer of light vehicle power, and maintenance of light vehicle electricity.

The relevance of physics learning in automotive vocational schools is seen in two respects, namely the relevance of physics material to the basic competencies of TKR and the relevance of physics values to the automotive value of students.

Relevance of Physics Material with TKR Competence

Based on the attachment to the Decree of the Director General of Primary and Secondary Education Number 130 of 2017, the physics subjects of the TKR Competency Skills 2013 curriculum consist of fourteen basic competencies. Based on the analysis of fourteen basic physics competencies, one physical material is not relevant to the basic competencies of TKR. Determination of relevant and irrelevant based on the criteria of proximity of physics material with basic competencies of TKR, whether or not the use of physics material is in the basic competencies of TKR, and priority scale. The results of the analysis of the relevance of physics material to TKR basic competencies are shown in Table 1.

Table 1. Relevance of Physics Material

No	Physics Material	Relevance
1	Measurement of physical quantities	Relevance
2	Straight motion and circular motion	Irrelevant
3	Newton's Laws	Relevance
4	Work, energy, power, and efficiency	Relevance
5	Momentum, impulse, and law of conservation of momentum	Relevance
6	Torque, moment of inertia, and angular momentum	Relevance
7	Material elasticity	Relevance
8	Fluid static and dynamic	Relevance
9	Vibrations, waves, and sounds	Relevance
10	Temperature and heat	Relevance
11	The laws of thermodynamics	Relevance
12	Electricity is static and dynamic	Relevance
13	The laws of magnetism	Relevance
14	Electricity of alternating current (AC)	Relevance

In the subject of basic automotive technology, relevant physical material is energy, fluid, temperature, heat, thermodynamics and dynamic electricity. In the subject of basic automotive work requires material physics which includes measurement, Newton's law, effort, torque, and fluid. On the subject of maintenance of light vehicle engines requires material physics which includes measurement, Newton's law, effort, energy, power, efficiency, momentum, torque, fluid, vibration, wave, sound, temperature and heat, and thermodynamics. On the subject of chassis maintenance and transfer of light vehicle power requires the material of measurement physics, Newton's law, effort, energy, momentum, torque, elasticity of material, fluid, vibration, wave, sound, temperature, heat, and thermodynamics. In electrical vehicle maintenance subjects, light vehicles only require

dynamic electrical material, magnetic laws, and alternating current electricity.

Basic competencies evaluating straight motion and circular motion with fixed speed or constant acceleration in daily life are described in several sub-topics, namely the concepts of motion, straight motion, and circular motion. This basic competency is not relevant to TKR competencies in SMK. Physical material that is not relevant to TKR subjects does not mean that it must be eliminated, but there are two possibilities that must be considered. The first possibility, irrelevant material is a prerequisite before studying other physics material. The possibility of these two physics materials is more needed in designing light vehicle products that will be studied in college. Basically in automotive vocational schools, students only learn about the care and maintenance of light vehicle engine (Gunadi et al., 2014).

In compiling SMK physics material as a basic subject of vocational course the government has considered its relevance to the vocational field being studied, so that the preparation of the material refers to a certain set of rules and systematics. That the education curriculum must be comprehensive and responsive to social dynamics, relevant, not overloaded and able to accommodate diversity and technological progress (Ramdani et al., 2012).

Relevance of Physics Value of Students with Automotive Ability

Data on the results of physics subject tests 99 students from three SMKs in Pekalongan are presented in Table 2.

Table 2. Data on Physics Subject Test Results

School Name	The highest Value	The Lowest Value	Average Value
SMK Negeri 1 Kedungwuni	85.00	12.50	57.70
SMK Muhammadiyah Kajen	82.50	20.00	43.71
SMK Muhammadiyah Bligo	72.50	17.50	37.50

Table 2 shows that overall the average physics value of students is still low. However, when viewed from the acquisition score of each number, there are several basic competencies that achieve high scores, namely the basic competencies of measurement, energy, efficiency, static fluid, thermodynamics and dynamic electricity. The results of interviews with students, most of them stated that the physics materials were contextual with automotive learning, so they mastered and understood these basic competencies. This shows that students easily understand the concept of physics if the physics material is relevant to the automotive field, especially automotive practice. Students learn well about what interests them, and meaningful content is better learned and maintained than less meaningful content (Sahin & Yagbasan, 2012).

In other basic competencies the student score is still low. The results of the interview show that students find it difficult to understand physics that is less contextual with the automotive field that is being studied and considers that the physics material cannot be applied in automotive practice. In line with the opinion of Hartini (2011) students consider physics as a theory that cannot be applied in the fields of automotive or technology.

Students' practical skills in Light Vehicle Engineering (TKR) were obtained from documentation of odd semester TKR practice scores obtained from automotive practice teachers. Data on the value of automotive

practice of students from all three schools is presented in Table 3.

Table 3. Data on TKR Practice Values

School Name	The highest Value	The Lowest Value	Average Value
SMK Negeri 1 Kedungwuni	90.67	79.67	83.35
SMK Muhammadiyah Kajen	83.00	76.00	79.21
SMK Muhammadiyah Bligo	78.67	74.67	77.75

Table 3 shows that the majority of students have high automotive skills. This result is contrary to the results of student physics tests that are still low. This is due to automotive practice learning emphasizing motor activities, namely activities that emphasize the skills of the hands or other limbs. Learning in automotive practices is in accordance with the learning styles of vocational students, so that they can learn with the convenience of their learning. Learning comfort has an impact on student learning achievement.

Learning in automotive practice emphasizes motor activity, namely activities that emphasize hand skills. Learning activities like this have been proven to be more attractive to students. Students are more interested because they are required to conduct experiments. This argument is based on the concept of learning by doing theory which holds that students can learn better when they are doing or directly involved. Doing activities will be more meaningful, because in the process of transfer of knowledge students are directly involved in learning experiences, and this allows the concepts they learn to be firmly embedded in their memory. Learning that is oriented towards doing activities provides more reinforcement in the process of knowledge transfer.

In this case the contribution of the theory of physics to the practical abilities of students is relatively small. The small contribution of mastery of physics theory to practice indicates that mastery of students' automotive practices is obtained from the process of trial and error. However, the influence of mastery of physical theory cannot be ignored, because theory is the main foundation for carrying out practical activities. Theory is considered as an initial knowledge in a work practice and must be studied and understood before it can practice (Kilbrink, 2012; Jarvis et al., 2012, and Sukardi et al., 2015). In addition, conceptual understanding is an important part of the competencies and skills students must have in engineering (Streveler et al., 2008).

CONCLUSION

Thirteen physics materials relevant to the basic competencies of Light Vehicle Engineering (TKR) and one physical material are not relevant to TKR's basic competencies, namely material for straight motion and circular motion. The physics value of SMK students is still low in contrast to the value of students' automotive practices. This shows that students' physical abilities have not become the basis for learning automotive practices.

REFERENCES

Gunadi, Usman, T., & Nugraha, B.S. (2014). Identifikasi Kompetensi Fisika SMK Program Studi Otomotif dalam Rangka Implementasi Kebijakan Kurikulum 2013. *Jurnal Pendidikan Teknologi dan Kejuruan*, 22 (2), 155-162.

Hartini, P. (2011). Pengembangan Model Pembelajaran Fisika Melalui Kegiatan Bengkel Otomotif untuk Menumbuhkan Soft Skills Siswa. *Jurnal Penelitian Pendidikan*, 1 (2), 190-199.

Harto, K. (2018). Tantangan Dosen PTKI di Era Industri 4.0. *Jurnal Pemikiran dan Penelitian Pendidikan*, 16 (1), 1-15.

Ibrahim, R. (2011). *Kurikulum dan Pembelajaran*. Jakarta: Raja Grafindo Persada.

Jarvis, P., Holford, J., & Griffin, C. (2012). *The Theory and Practice of Learning (2nd) Edition*. London: Taylor & Francis e-Library.

Jatmoko, D. (2013). Relevansi Kurikulum SMK Kompetensi Keahlian Teknik Kendaraan Ringan terhadap Kebutuhan Dunia Industri di Kabupaten Sleman. *Jurnal Pendidikan Vokasi*, 3 (1), 1-13.

Kilbrink, N. (2012). Theory and Practice in Technical Vocational Education: Pupils, Teachers and Supervisors Experiences. *Technical Vocational Education*, 10 (1), 247–252.

Luthvitasari, N., Made, N. D. P., & Linuwih, S. (2012). Implementasi Pembelajaran Fisiks Berbasis Proyek terhadap Keterampilan Berpikir Kritis, Berpikir Kreatif, dan Keterampilan Generik Sains. *Journal of Innovative Science Education*, 1 (2), 92-97.

Maulana, F. & Winanti, E. T. (2016). Relevansi Materi Pembelajaran pada Paket KeahlianTeknik Gambar Bangunan pada Kurikulum 2013 terhadap Kebutuhan Tenaga Kerja di Konsultan Perencana. *Jurnal Kajian Pendidikan Teknik Bangunan*, 3 (3), 165-171.

Ramdani, S. D., Suwachid, & Estriyanto, Y. (2012). Relevansi Mata Kuliah Berkarya (MKB) Konsentrasi Mesin Otomotif pada Pragram Studi Pendidikan Teknik Mesin Universitas Sebelas Maret Surakarta dengan Kebutuhan Industri Jasa Otomotif dan Sekolah Menengah Kejuruan. *NOSEL*, 1 (1), 56-64.

Sahin, E. & Yagbasan, R. (2012). Determining which introductory physics topics pre-service physics teachers have difficulty understanding and what accounts for these difficulties, *European Journal of Physics*, 33 (1), 315–325.

Saolika, M. D., Mahardika, I. K., & Yushardi. (2012). Meningkatkan Multirepresentasi Fisika Melalui Penerapan Model Problem Solving Secara Berkelompok Disertai Software PSIM di SMK (Hukum kelistrikan Arus Searah). *Jurnal Pembelajaran Fisika*, 1(3), 252-260.

Streveler, R. A., Litzinger, T. A., Miller, R. L., & Steif, P. S. (2008). Learning conceptual knowledge in the engineering sciences: Overview and future research directions. *Journal of Engineering Education*, 97 (1), 279–294.

Sukardi, Sunardi, & Sampe, L. (2015). Hubungan Penguasaan Teori dengan Keterampilan Merangkai Kelistrikan Otomotif. *Jurnal Teknologi dan Kejuruan*, 38 (1), 65-76.

Wheelahan, L. (2015). Not just skills: what a focus on knowledge means for vocational education. *Journal of Curriculum Studies*, 47 (6), 750-762.

Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). Intelligent Manufacturing in the Context of Industry 4.0. *Engineering*, 3 (5), 616-630.