

Development of Trainer Kit Quality Control (TKQC) on Motorcycle Electrical Competencies

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Abstract—This study aims to produce Trainer Kit Quality Control (TKQC) on motorcycle electrical competencies, and the effectiveness of TKQC is obtained in improving understanding of the basics of motorcycle electrical lighting systems. Research methods using research and development (Research and Development). First test respondents (small scale) were 18 students and 4 automotive teachers, while second test (large-scale) were 36 students and 7 automotive teachers. Data collection instruments were by questionnaires, the results of small and large scale testing were used to revise TKQC. The results showed that TKQC was developed in accordance with the basic competencies of motorcycle electricity, produced at a low cost, simple, flexible, practical, based on the average response of practitioners 81.06% or it means good, and experts response showing an average of 82.39% or it means in good qualifications. The results of large-scale trials on 5 components namely visibility, interesting, simple, useful and accurate as a whole showed an average of 94.70% for teachers and showed an average of 93.36% for students is included in very good qualifications. The effectiveness of TKQC seems to be seen in students who are more enthusiastic and eager to learn, TKQC makes it easy for students in the learning process, TKQC is easy to operate, students can learn independently.

Keywords—*trainer kit; quality control; competency; wiringharness motorcycle*

I. INTRODUCTION

Vocational secondary education is education at the secondary education level which prioritizes the development of students' ability to carry out certain types of work. Vocational secondary education prioritizes the preparation of students to enter employment and develop professional attitudes [1]. The automotive industry is currently more focused on developing electric and hybrid energy engines. Many product quality problems are related to cable assembly. In particular, the assembly of electrical cables and the utilization of cables are difficult because of their vehicle-adjusted position, some branching points, material weight and cable flexibility. To avoid delays in detecting assembly problems, assembly aspects must be considered from the start, namely during the design and assembly of vehicle cables [2]. In the industry manual automotive assembly wiring harnesses are very common, especially in companies that produce various types of wiring harnesses [3]. Research on vehicle cable assembly has been

carried out by many researchers, connecting a pair of electrical connectors is one of the most important steps in the wiring harness assembly system. The hierarchical multidensity classifier matching pattern is proposed to be able to detect errors and diagnoses for the installation process. The connector plans and finds the smooth installation and collision-free Connector when assembling wiring harness [4].

The study of relevant research included the development of an arduino-based sensor kit trainer as a learning medium in programming engineering subjects, based on the research conducted, it was obtained the results of the competence of students who were taught using the arduino-based sensor kit trainer to obtain an average increase of 81.75 [5]. Development of Mobile Robot Quadcopter Kit Media Trainer in the Robotics Course of the Department of Electrical Engineering Faculty of Engineering, State University of Malang, Based on the results of the trial, the product development in the form of a mobile quadcopter robot trainer kit, manual books, and practicum modules are categorized as very feasible to be implemented as a learning media in the eyes lecture Robotics Department of Electrical Engineering Faculty of Engineering, State University of Malang [6]. Development of Electromagnetic Trainer Demonstration as Basic Learning Media for Electricity Concepts, Analysis of learning outcomes shows that after being given learning using electromagnetic trainer displays there was an increase in learning outcomes in the experimental group [7]. PLC Kit Development has been designed and improved by increasing the number of input and output components, reducing costs and also user friendly. Based on the Practical Lab records of students, it was found that there was 39% increase in hand knowledge and skills when students used the PLC Kit [8]. Standard training through simulation as an additional education can improve students' skill achievement more quickly and completely, the authors hypothesize that simulation training will also improve performance [9]. Trainer kits can replace expensive equipment with alternatives easily sent and used by students who do not have formal laboratory space, trainer kits greatly enhance the accessibility of laboratory experience for students in campus laboratories who are budget-short [10]. Software simulators for microcontrollers are expensive or too complicated to be used in laboratory classes in learning, trainer kits developed at low cost based on microcontrollers are suitable for learning in the laboratory.

Practical applications indicate that trainer kits developed at low cost can improve students' understanding [11].

II. RESEARCH METHODS

Research and development method (Research and Development) is one method of research, research and development is a process used to validate and develop products, developing products can be in the form of updating existing products so that they become more practical, effective, and efficient [12].

The population in this study were all students of Motorcycle Engineering class XI 2017/2018 Academic Year totaling 64 people, and all automotive productive teachers of Subang 2 State Vocational High Schools totaling 7 people. Sampling was carried out by proportional random sampling technique so from a total population of 64 people were selected as samples for phase 1 trials (small scale trials) namely 18 students and 4 teachers, and for phase 2 trials (large scale trials) samples were selected from 36 students and 7 teachers.

III. ANALYSIS OF DATA

The instrument used in this study is a questionnaire, the questionnaire used is a questionnaire that has been equipped with alternative answers so that the respondent just gives an answer by circling or with a checklist (V). The score used to give scores using a Likert scale with 4 answer choices. Assessment of the answers to each instrument item is given a value in the range 1-4. Questionnaires were given to students and teachers during small-scale and large-scale tests, while at the time of developing the initial design of TKQC validation testing was done by experts and practitioners. Experts from UPI FPTK lecturers and practitioners from the wiring harness industry, namely PT. Kinenta Indonesia.

The formula used to calculate the percentage of each subject:

$$\text{Persentase} = \frac{\sum x}{SMI} \times 100\%$$

Description:

$\sum x$ = Total score,

SMI = Ideal Maximum Score

Then to calculate the percentage of the entire subject used the formula:

$$\text{Percentage} = F : N$$

Description:

F = Total percentage of all subjects,

N = many subjects

To be able to give meaning and decision making, the following provisions are used:

TABLE I. CONVERSION OF ACHIEVEMENT LEVELS WITH SCALE 5

Achievement Level	Qualification	Description
90 % - 100 %	Very Good	No need to be revised
75 % - 89 %	Good	Revised as needed
65 % - 74 %	Enough	Pretty much revised
55 % - 64 %	Less	Many revised
0 - 54 %	Very Less	Revised Total

Source [13]

IV. DISCUSSION

TABLE II. PRACTITIONER'S RESPONSE

No	Component				
1	KQC is in accordance with the SK-KD of motorbike electricity.				
2	Produced at a low cost, in accordance with school finances.				
3	Simple, easy to make and maintain.				
4	Flexible is easy to move				
5	Practically easy to use by vocational students				
component	In accordance with SK-KD,	Cheap production costs	Simple	Flexible	Practical
average	79,19%	85,41%	76,66%	87,50%	78,33%

Table 2 shows that the TKQC developed in accordance with competency standards (SK-KD) on Motorcycle Engineering Skills Competencies, is produced at a low cost, is simple, easy to manufacture and maintain, designed to be flexible so that it is easy to move, practically easy to use by vocational students. Validation test results by industry practitioners showed an average of 81.06 entered in good qualifications.

TABLE III. EXPERT RESPONSE

No	Component				
1	KQC is in accordance with the SK-KD of motorbike electricity.				
2	Produced at a low cost, in accordance with school finances.				
3	Simple, easy to make and maintain.				
4	Flexible is easy to move				
5	Practically easy to use by vocational students				
component	In accordance with SK-KD,	Cheap production costs	Simple	Flexible	Practical
Average	84,37%	87,50%	77,08%	87,50%	77,08%

Table 3 shows that TKQC which was developed based on expert validation tests showed an average of 82.39% entered into good qualifications and TKQC was revised according to suggestions and comments from industry experts and practitioners.

TABLE IV. STUDENT RESPONSE

No	Component				
1	Visibel,				
2	Interesting,				
3	Simple,				
4	Useful,				
5	Accurate,				
component	Visibel	Interesting	Simple	Useful	Accurate
average	91,84%	93,57%	92,18%	93,28%	95,94%

Table 4 TKQC developed in accordance with the criteria of the trainer kit that is visible or easy to see, interesting or interesting, simple or simple, useful or useful and accurate that is correct and on target. There are 2 visible indicators, namely TKQC that is easy to read and easily accessible, the result is an average of 91.84%, indicating the validity test results are in good qualification. Interesting or interesting has 2 indicators, namely TKQC attracts students' interest to study the series of electrical motorbikes and TKQC increases students' motivation to learn motorbike electrical material as a result 93.57% in good qualifications.

TKQC, which is simple or simple, can be seen from two indicators, which are simple and easy to operate, with an average result of 92.18%, in good qualifications. Useful or TKQC is useful to have 2 indicators, namely TKQC makes it easy for students to understand the series of electrical motorbikes and TKQC helps students in detecting electrical circuit errors resulting in an average of 93.28% in good qualification. Accurate is TKQC right and right from two indicators, TKQC is suitable to be used as a learning media on the material of the motorbike electrical circuit and TKQC can detect electrical circuit errors that are difficult to see visually, the average result is 95.94% in good qualifications. From the results of large-scale trials to students as a whole showed an average of 93.36% entered in very good qualifications and TKQC was revised according to students' suggestions and comments.

TABLE V. TEACHER'S RESPONSES

No	Component				
1	Visibel,				
2	Interesting,				
3	Simple,				
4	Useful,				
5	Accurate,				
Component	Visibel	Interesting	Simple	Useful	Accurate
Average	94,94%	94,64%	92,85%	94,64%	96,42%

Table 5 TKQC developed in accordance with the criteria of the trainer kit that is visible or easy to see, interesting or interesting, simple or simple, useful or useful and accurate that is correct and on target. Visible indicators are 2, namely TKQC, easy to read and easily accessible, the result is an average of 94.94%, indicating validity test results are in good qualification. Interesting or interesting has 2 indicators, namely TKQC attracts students' interest to study the motorbike electrical circuit and TKQC increases student motivation to learn motorbike electrical engineering as a result 94.64% in good qualifications.

TKQC, which is simple or simple, can be seen from two indicators, which are simple and easy to operate, with an average result of 92.85%, in good qualifications. Useful or TKQC is useful to have 2 indicators, namely TKQC makes it easy for students to understand the series of electrical motorbikes and TKQC helps students detect faults in the electrical circuit, with an average of 94.64% in good qualifications. Accurate is TKQC correct and right from two indicators, TKQC is suitable to be used as a learning media on the material of the motorbike electrical circuit and TKQC can

detect electrical circuit errors that are difficult to see visually, the average result is 96.42% in good qualifications. From the results of large-scale trials to the teacher as a whole showed an average of 94.70% entered in very good qualifications and TKQC was revised according to teacher's suggestions and comments.



Fig. 1. The final product of TKQC.

Figure 1 is the final result of TKQC based on the initial design, revision phase 1, revision phase 2 and revised stage 3. The final product of TKQC is in the form of a trainer kit quality control on motorbike electrical competence which is equipped with Standard Operating Procedure (SOP), drawing or drawing work and manual book.

The effectiveness of TKQC can be seen based on the interesting and easy to use TKQC teacher responses so that it can attract students' interest in motorbike electrical subjects and students seem more enthusiastic to learn. Based on the responses of TKQC students, they have simple characteristics, are easy to use, interesting and not boring so they are more enthusiastic to learn. Effective learning media is used in the process of learning productive competence [14].

Automotive teachers in large-scale trials giving TKQC comments can be used as learning media for vocational school students in motorcycle engineering skills and students also comment that TKQC is used by students of SMK Negeri 2 Subang in the school workshop. Students can use the media in a series of ways to improve learning [15].

V. CONCLUSION

- The development of TKQC as a learning media for motorbike electrical circuits has the characteristics of TKQC developed in accordance with the basic competencies of motorbike electricity, produced at a low cost, simple, flexible, practical based on practitioner responses on average 81.06% or good and expert responses showing average 82.39% or in good qualifications. The resulting TKQC has the characteristics of visible, interesting, simple, useful, accurate based on the teacher's response showing an average of 94.70% or very good and the average student responses 93.36% so that it entered the qualification very well.

- The effectiveness of TKQC in improving understanding of the basics of the motorcycle electrical lighting system based on the TKQC teacher's interesting and easy-to-use responses so as to attract students' interest in motorbike electrical subjects and students seem more enthusiastic to learn. Based on the responses of TKQC students, they have simple characteristics, are easy to use, interesting and not boring so they are more enthusiastic to learn. The media can increase interest in a subject, the media can attract students' attention, maintain their attention, and create involvement in the learning process [15].
- TKQC has advantages and disadvantages as follows: TKQC has the advantage of being able to overcome the limitations of visually checking motorcycle cables, providing convenience in the learning process, more interesting learning, can be studied independently by students repeatedly, easy to operate, TKQC can be produced by school. TKQC has drawbacks, among others, the material is still limited to the competence of carrying out inspection of the series of motorcycle electrical systems and carrying out a series of electrical system tests to determine disturbances and errors.

REFERENCES

- [1] S. Sonnentag and M. Frese, "Performance concepts and performance theory," *Psychol. Manag. Individ. Perform.*, pp. 3–25, 2002.
- [2] A.M. Herghelegiu, G.I. Prada, and R.M. Nacu, "Computer and Internet Literacy in Older Age," 2015 E-Health Bioeng. Conf. EHB 2015, pp. 21–24, 2016.
- [3] J. Tilindis and V. Kleiza, "The effect of learning factors due to low volume order fluctuations in the automotive wiring harness production," in *Procedia CIRP*, vol. 19, no. C, pp. 129–134, 2014.
- [4] T. Hermansson, R. Bohlin, J.S. Carlson, and R. Söderberg, "Automatic assembly path planning for wiring harness installations," *J. Manuf. Syst.*, vol. 32, no. 3, pp. 417–422, 2013.
- [5] F. Alan, "Pengembangan Trainer Kit Sensor Berbasis Arduino Sebagai Media Pembelajaran Pada Mata Pelajaran Teknik Pemrograman Di Smkn 1 Jetis," *Pendidik. Tek. Elektro*, vol. 06, pp. 409–415, 2017.
- [6] R. Andria, Suwasono, and S. Sondari, "Pengembangan Media Trainer Kit Mobile Robot Quadcopter Pada Mata Kuliah Robotika Jurusan Teknik Elektro Fakultas Teknik Universitas Negeri Malang," *J. Teknol. Elektro Dan Kejuru.*, vol. 38, no. September, 2015.
- [7] Y.B. Wirawan, "Pengembangan Peraga Trainer Elektromagnetik Sebagai Media Pembelajaran Konsep Kelistrikan Dasar," *J. Pendidik. Tek. Mesin*, vol. 16, no. 1, pp. 48–52, 2016.
- [8] I. Burhan, S. Talib, and A.A. Azman, "Design and fabrication of Programmable Logic Controller Kit with multiple output module for teaching and learning purposes," in *Proceedings - 2012 IEEE 8th International Colloquium on Signal Processing and Its Applications, CSPA 2012*, 2012.
- [9] N.A. Ferrero, A.V. Bortsov, H. Arora, S.M. Martinelli, L.M. Kolarczyk, E.C. Teeter, and P.A. Kumar, "Simulator training enhances resident performance in transesophageal echocardiography," *Anesthesiology: The Journal of the American Society of Anesthesiologists*, vol. 120, no. 1, pp. 149–159, 2014.
- [10] R.M. Reck and R.S. Sreenivas, "Developing a new affordable DC motor laboratory kit for an existing undergraduate controls course," in *Proceedings of the American Control Conference*, 2015, vol. 2015–July, pp. 2801–2806.
- [11] C. Ma, Q. Li, Z. Liu, and Y. Jin, "Low cost AVR microcontroller development kit for undergraduate laboratory and take-home pedagogies," in *ICETC 2010 - 2010 2nd International Conference on Education Technology and Computer*, vol. 1, 2010.
- [12] J.W. Creswell, *Qualitative, Quantitative, and Mixed Methods Approaches*, 3rd ed. Los Angeles: SAGE Publication Ltd., 2009.
- [13] M. Tengeh, N. Jampel, and K. Pudjawan, *Model Penelitian Pengembangan*. Yogyakarta: Graha Ilmu, 2014.
- [14] A.M. Izzudin, M. Masugino, and A. Suharmanto, "Efektivitas Penggunaan Media Pembelajaran Video Interaktif Untuk Meningkatkan Hasil Belajar Praktik Service Engine Dan Komponen-Komponennya," *Automotive Science and Education Journal*, vol. 2, No. 2, 2013.
- [15] S.E. Smaldino, D.L. Lowther, and J.D. Russell, *Instructional technology and media for learning: teknologi pembelajaran dan media untuk belajar*. Prenada Media, 2014.