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Development of Basic Electronic Practices Module in Vocational Schools

Moch Sukardjo[1], Uswatun Khasanah[2], Fatur Rahman[3]

[1] Education Technology, Postgraduate Program, State University of Jakarta, Jln Rawamangun Muka East Jakarta, Indonesia

[2] Elementary School Teacher Education, Faculty of Social and Humanities, Lampung Nahdlatul Ulama University, Mataram Marga, Sukadana, East Lampung Regency, Lampung, Indonesia

[3] Electronics Engineering Education student, Faculty of Engineering, State University of Jakarta, Indonesia

Abstract: Before students majoring in Audio-Video (AV) engineering class X at Vocational High Schools take the next lesson, mastering Basic Electrical and Electronics Subjects, both in theory and practice, is one of the basic competencies for them. In addition to the theoretical knowledge in the Basic Electrical and Electronics course, students also practice measuring resistors, capacitors, coils, transistors, and other components. Thus, students are expected to gain meaningful experience when learning about the basics of electricity and electronics. Vocational education aims to train graduates to work with technical competencies, to improve their position in society through the skills they master. Vocational high schools also prepare students to develop professionalism in working according to their expertise independently and productively. This research was conducted to develop and find out the feasibility of basic electronics modules as a practicing medium in SMK Negeri 7 Bekasi City. This study used a research and development (R&D) method by adopting the Hannafin and Peck development model. A Likert scale survey was conducted for collecting data from students; the questionnaire was modified with four options, while the test instrument was applied to measure the level of student mastery of the material being taught. The feasibility of the practice module is based on the results of expert assessments, namely (1) assessment by material experts with a percentage gain of 92.50%, (2) assessment by media experts with a percentage gain of 82.60%, (3) assessment of student usage getting a percentage of 86.89%. The results of the experts and students' assessments suggest that the basic electronics practice module meets the requirements, is feasible and effective to be used as a learning medium for Elementary Electricity and Electronics in class X Audio-Video Engineering Department in Vocational High Schools.

Keywords: basic electronics practice module, audio-video, vocational high school.

职业学校基本电子实践模块的开发

摘要：在职业高中学习音视频（影音）工程 X 类的学生上下一课之前，掌握理论和实践上的基础电气和电子学科是他们的基本能力之一。除了基础电气和电子课程的理论知识外，学生还练习测量电阻器，电容器，线圈，晶体管和其他组件。因此，期望学生在学习电气和电子基础知识时获得有意义的经验。职业教育旨在训练毕业生具有技术能力，通过他们掌握的技能来提高他们在社会中的地位。职业高中还准备让学生发展自己的专业知识，从而根据自己的专业知识进行独立高效的工作。进行这项研究的目的是开发并发现基本电子模块作为贝卡西市 SMK 内吉里 7 的实践媒介的可行性。本研究通过采用汉纳芬和啄开发模型，采用了研究与开发（研发）方法。

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About the authors: Moch Sukardjo, Education Technology, Postgraduate Program, State University of Jakarta, Indonesia; Uswatun Khasanah, Elementary School Teacher Education, Faculty of Social and Humanities, Lampung Nahdlatul Ulama University, Indonesia; Fatur Rahman, Electronics Engineering Education student, Faculty of Engineering, State University of Jakarta, Indonesia

Corresponding author Moch Sukardjo, msoekardjo@unj.ac.id

进行李克特量表调查以收集学生的数据；问卷通过四个选项进行了修改，同时使用了测试仪器来衡量学生对所教授材料的掌握程度。实践模块的可行性基于专家评估的结果，即（1）由材料专家评估的收益率为 92.50%，（2）由媒体专家评估的收益率为 82.60%，（3）评估占学生使用率的 86.89%。专家和学生的评估结果表明，基本的电子实践模块符合要求，既可行又有效，可以用作职业高中 X 音频视频工程系的基础电气和电子学习介质。

关键词：基本电子实践模块，视听，职业高中。

1. Introduction

In improving the quality of human resources (HR), schools play a very important role. A learning process can run well if there is good interaction between students and professional teaching staff. Interaction can occur with the help of anything that can be used to send or convey messages or information from sender to recipient, which is often referred to as a medium that can stimulate students' thoughts and feelings, and concerns in such a way that the learning process occurs [1]. In the learning process, the teacher acts as a figure who helps, guides/ and facilitates students. From the results of the research [2], the teacher's task as a motivator, director, guide, and facilitator has proven to be very helpful for students in the learning process. Therefore, teachers in learning activities must be oriented towards student-centered learning, not teacher-centered.

On the other hand, teachers have not optimized the role of learning media in the learning process to facilitate students' understanding of the material being studied. Learning media that are deliberately designed for the needs of students in learning can increase student motivation. Eyler and Giles' research proves that the effectiveness of learning is influenced by the media used by the teacher [3].

According to [4], instructional media at the learning orientation stage will greatly help the effectiveness of the learning process, improve understanding, facilitate data interpretation, and condense information. Another research [5] aimed to see the appropriateness of e-module learning media to improve learning outcomes in basic electromechanical work subjects. The results showed that the e-module learning media was very suitable for learning activities with a percentage of 95.3%. From the results of these studies, it can be seen that learning is media has an important role in improving student learning outcomes.

The use of appropriate media according to student needs can motivate and attract students to be more active in participating in the learning process. Project-based electronic modules were developed to improve learning outcomes in basic programming learning [6]. The development of learning modules that are integrated with audiovisual media can also be used as learning materials carried out by teachers in class [7]. development of these modules was very effective; they were used by 30 students and showed a significant increase based on the results of the t-test with a significance level of 5%. The results of the design and material expert's assessment demonstrated that this product was quite feasible (8.6%), feasible (71.4%), and very feasible (20%).

Nevertheless, as stated above, the reality in the field that happened at Vocational High School Negeri 7 Bekasi was not implemented properly to improve the quality of learning. Also, besides the means for practice are very minimal. This learning media should make students actively carry out the learning process to get meaningful learning experiences. The learning media used in each learning activity must also be in accordance with the material to be delivered by the teacher because not all media can be used in all learning materials. Therefore, when designing an electronic module, one must look at its practicality in its use and adapt to students' needs and characteristics. Electronics module design must pay attention to the principles of instructional media: the, and. The first is practicality in operating it; second, learning media must also be by following under the characteristics of students who will use it. The third is a practical means to facilitate learning activities [8].

When identifying students' needs in the learning assessment process it is important to find out the right learning media to be used in the learning process. Needs analysis is carried out to refer to the achievement of

optimal student learning outcomes as expected [9]. Student learning outcomes increased from 68.53 to 80.24 because students made use of learning media, which greatly influenced their success in learning [10].

Referring to previous studies, the difference in this study lies in the basic electronic practice module in which some components are really good and damaged. Preliminary observations made by researchers also support this conclusion; the process of learning activities for Basic Electrical and Electronics subjects in the Audio and Video Engineering Department at 7 Bekasi Vocational High School has not been effective. There are still many students who have difficulty understanding and analyzing the material on electronic components. Limited media and facilities condition the difficulty that helps students understand learning material; therefore, students who practice cannot take advantage of the time determined by the parties. In connection with this, the competency standards in Basic Electrical and Electronics subjects need to be improved in the learning process; it is hoped that students have sufficient knowledge and a strong understanding of the basic mastery of electricity and electronics. Thus, students can have predetermined competency standards for prospective students to enter the world of work.

From the above explanation, it is necessary to develop learning media that can help the process in learning Basic Electricity and Electronics, on basic competencies in identifying physical and non-physical conditions and measuring passive and active electronic components that can provide an overview, skills, and knowledge, so that the competency standards fulfilled. The learning media referred to is the Basic Electronics Practice Module. With the Development of Basic Electronics Practice Modules for Basic Electrical and Electronics Subjects, it is hoped that students can easily carry out the process of analyzing the physical state and measuring an electronic component.

2. Literature Review

Basic electronics practice modules in vocational high schools are needed as support in the learning process activities. This module is designed to make it easier for students to understand and practice basic electricity and electronics subjects. The purpose of designing this instructional media is to develop students' abilities in analyzing physical conditions and measuring an electronic component.

The use of practice modules as a learning medium greatly affects student learning outcomes. The electronics practice module as a learning medium can affect students' learning success because the electronic practice module can be seen in real terms and can be practiced directly by students, making it easier for students to understand and learn learning materials for electronic components.

Learning media are all components of learning resources that can stimulate students to learn [11], including physical means for conveying learning content or materials such as books, films, videos, etc. [12]. Furthermore, according to [8], learning media include traditional media such as chalkboards, blackboards, textbooks, and modern facilities such as video, tape recorders, computers, overhead projectors, and others employed in the instructional activities to be conveyed to students.

This electronics practice module designed has several advantages to be used in the learning process, including

1. the fundamental components for active components (transistors, diodes, and integrated circuits) and passive components (resistors, inductors, and capacitors).
2. It makes possible to directly determine whether the components are active or passive
3. This electronic practice module contains the basic components of electronics, so it is very important to master it because it becomes the basis for further practice.

This electronics practice module also has disadvantages, namely;

1. The electronics practice module is very basic, and in one package, it requires much money to design and manufacture the module product for each student to have one module.

This electronics practice module is not equipped with precision measuring instruments such as an ampere meter and voltmeter.

3. Research Methodology

The method used in this study is research and development (R&D) regarding educational research used to develop and validate educational products [13]. Furthermore, developmental research is defined as "the systematic study of designing, developing and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness" [14]. This research resulted in a product in the form of an electronics practice module and its development process by adopting the Hannafin and Peck model [15] The learning design model, which consists of three phases, namely the requirements analysis phase, the design phase, the development, and implementation phase, can be seen in Figure 1.

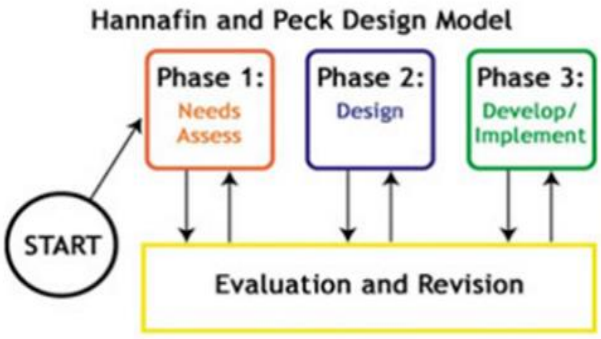

Fig. 1 Hannafin and Peck's development model

In this model, scoring and repetition need to be carried out in each phase. This model is more product-oriented, going through three phases:

1) At the first phase, needs were analyzed by identifying the needs and practical facilities in vocational high school 7 Bekasi, which needed practical facilities in the form of electronics modules.

2) At the second phase, the practice module design was developed in terms of component placement, artistic design, and ease of arrangement of component placement and ease of practice.

3) The third phase is the development and implementation phase. After the second step is deemed adequate, the design was implemented in assembling electronic components, both passive and active, according to the design developed at the second step.

Data collection was performed using a questionnaire survey for students and testing student learning outcomes, through interviews, and observations with teachers and students. The data analysis was made by applying the descriptive quantitative technique. Data regarding the feasibility of learning media for basic electronics practice modules by media experts, material experts, and students were collected according to the research and development method. The feasibility data used descriptive statistical analysis techniques. According [16], descriptive statistics were used to analyze the collected data as it was without intending to make general conclusions or generalizations.

4. Results

This basic electronic practice module was developed based on the analysis of needs at Vocational High School Negeri 7 Bekasi. There is no basic electronics practice module at the State Vocational High School 7 in Bekasi as a learning medium in learning activities on Basic Electrical and Electronics subjects. The development of this basic electronics module is designed to facilitate students' learning so that students' abilities increase in carrying out the process of analyzing physical conditions and measuring an electronic component properly. This electronics practice module is designed as a learning medium in passive and active electronic components that students hope to learn directly. An electronics module design is a piece of hardware used as basic equipment in the basic electrical and electronics practicum. In supporting practicum activities for Basic Electrical and Electronics subjects, an electronics practice module has been developed. Figure 2 shows the results of the basic electronics module design.

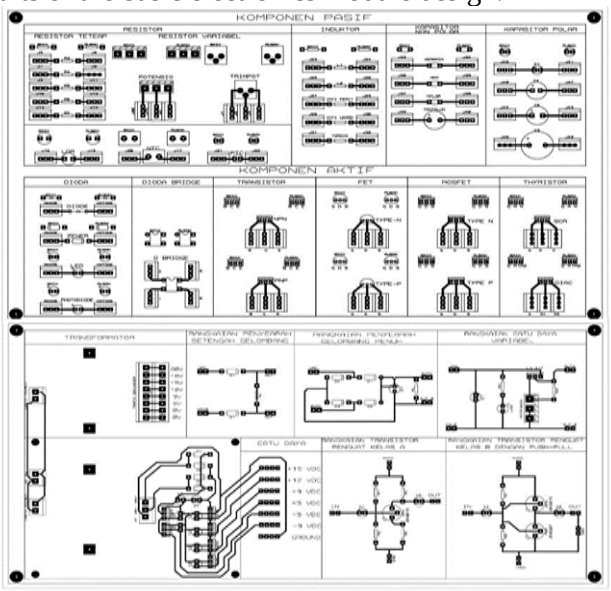

Fig. 2 Basic electronics module design

The development of this basic electronics module is through due diligence from two experts, namely, a material expert and a media expert. The researchers used a questionnaire given to students to see the satisfaction from using the electronics practice module. The results of the feasibility assessment of material and media experts in the basic electronics practice module are as follows:

4.1. Material Expert Assessment

Material expert assessment was carried out to assess hers of Basic Electrical and Electronics material, which includes material aspects. Figure 3 shows a recapitulation of the results of the material expert's validation. The learning module is done following the Vocational High School 7 Bekasi curriculum, which is passed down to the syllabus. Then from the syllabus, a lesson plan is made regarding the basic competencies of basic electricity and electronics subjects.

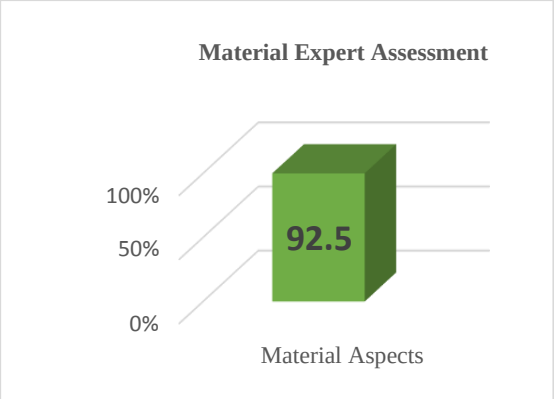

Fig. 3 Diagram of material expert assessment results

Based on Figure 3, the feasibility value of material experts is 92.5%. Therefore, the material presented in the electronic module can be categorized as very feasible for Vocational School Audio-Video Engineering students.

4.2. Media Expert Assessment

The media expert's assessment is carried out to assess whether or not the components and materials are assembled according to the design of the electronics practice module in Figure two. The expert's assessment includes several aspects: material, namely, aspects, and display aspects (component layout, the distance between components). The results of the media expert's assessment can be presented in Figure 4.

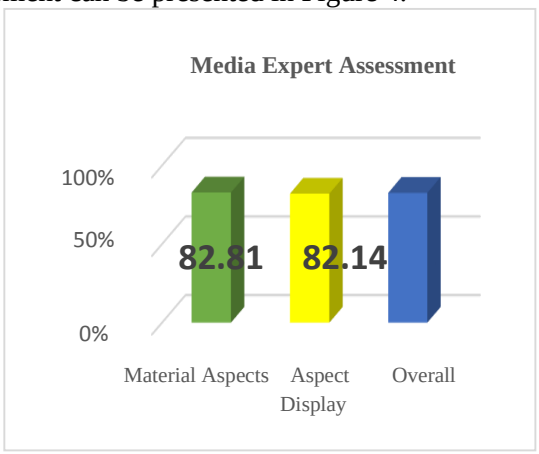

Fig. 4 Diagram of the results of the evaluation of media experts for each aspect

Based on Figure 4, the feasibility value of learning media from media experts in terms of the media aspect is 82.81%. In comparison, in terms of the Display Aspect, it gets a percentage of 82.14%; if each aspect is combined, it will get an overall percentage (average) amounted to 82.60%. Therefore, it can be said that the electronics practicum module as a learning medium is very suitable to be used for basic electronics and electricity practice for Vocational School students majoring in AV.

4.3. Student Usage Assessment Results

Product assessment was carried out by class X Audio Video Engineering students at Vocational High School 7 Bekasi. The following are the stages in collecting the feasibility of learning media data by filling out the feasibility questionnaire.

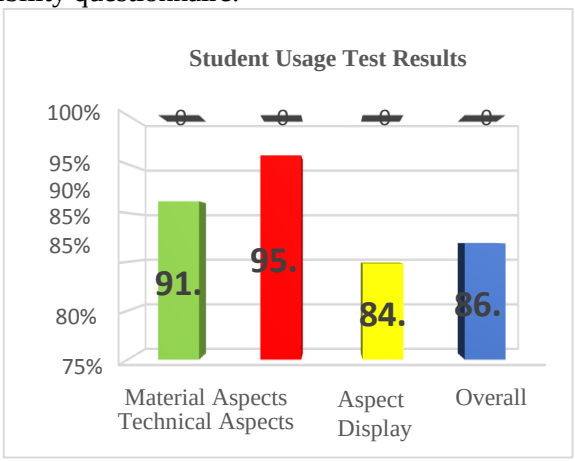

Fig. 5 Diagram of student assessment results for each aspect

Based on Figure 5, the data on the assessment results of using the learning media for the basic electronics practical module by 27 students in terms of material aspects get 91.20%, technical aspects get 95.89%, appearance aspects make 84.40%. Meanwhile, overall, it got 86.89%. Based on the table of the predetermined rating scale eligibility categories, it can be said that the learning media in the form of a practicum module can be categorized as very feasible to be used as a practice module learning media for Vocational School students of the AV Department.

4.4. Effectiveness of Using Electronics Practice Modules

After being field-tested at the Vocational High School 7 Bekasi, this electronics practice module, majoring in Audio-Video, proved to be very effective. These results can be seen from the pre-test and post-test scores as shown below:

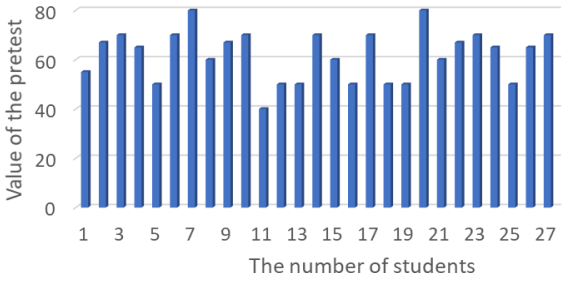

Fig. 6 The pre-test scores of class X students, before using the Electronics Practice Module

According to Figure 6 above, the lowest score of students is 40 (one student), and the highest is 80 (two

students). The other students' scores range from 50 to 75. Thus, from 27 students, according to the criteria valid in schools, only two students (7.4%) scored above the Minimum Completeness Criteria. The rest (93.6%) were under the Minimum Completeness Criteria. After conducting field trials using the electronics practice module, the students' post-test scores can be seen in Figure 7 below:

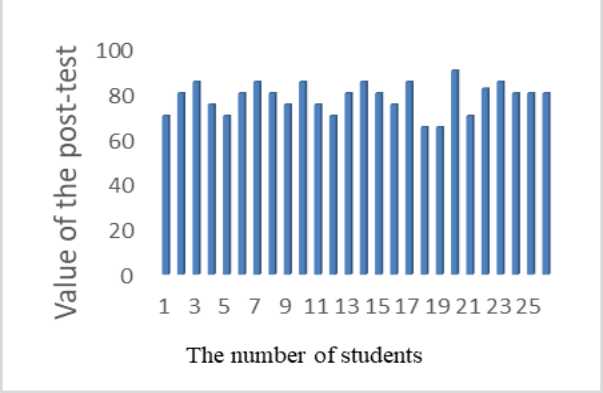

Fig. 7 Post-test scores of class X students after using the Eclectic Practical Module

Figure 7 shows that there are still scores of students who get under the Minimum Completeness Criteria, namely six students who scored between 65 and 70 or around (22.2%). The remaining 21 students scored above the Minimum Completeness Criteria (77.8%). The comparison between the pre-test and post-test values can be seen in Figure 8.

The comparison of the pre-test and post-test scores shows students' competencies have increased significantly; this means that the electronic practice module can increase understanding and mastery of the new physical state of the electronic components being taught. This module is effective for use in practical learning activities for Basic Electrical and Electronics subjects.

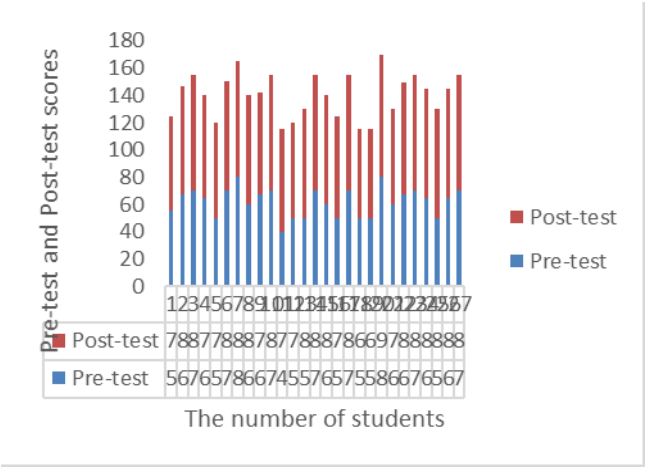

Fig. 8 Comparison scores of class X students' pretest and post-test

5. Discussion

This learning media is made in two stages: the design stage of the electronics practice module and the second stage of making the basic electronics practice module. Basic electronics practice modules are done by following the syllabus and basic competencies of basic electricity and electronics subjects. The basic electronics practice module consists of 2 parts. The first part describes the basic electronics practice module, how to use it, procedures for borrowing the module, and a list of components available in the basic electronics practice module. The second part contains a collection of job sheets that will be practiced. The basic electronics practice module is done in the form of one whole box. The basic electronics practice module block consists of an introduction block for Active components, passive components, simple electronic circuit blocks, namely half-wave rectifier, full-wave rectifier, variable power supply, class A amplifier, and class B amplifier.

Based on the feasibility assessment of learning media regarding basic electronics modules, experts obtain a valid and feasible category, from the media and display aspects of the basic electronics module, it has met the standard criteria and principles of making learning media and can be used as learning media for the assessment of material experts, the category of value is very feasible, which is adjusted from the curriculum, syllabus and lesson plans and the needs and characteristics of class X students of Vocational High School Negeri 7 Bekasi. The development of electronic learning modules was also developed and implemented by Rahmi in class X high school) which are valid based on saga text based on Project Based Learning (in terms of content, presentation, language, and graphics), practical (in terms of ease of use

and suitability for time), and effective (in terms of student activities, learning outcomes, and student affective) [17]. The good enough (high) value obtained by students after using the basic electronics practice module can be the basis that the module is feasible and can be used as a supporting medium in the experimental learning process to improve students' abilities in the process of analyzing physical conditions and measuring an electronic component.

An electronics module was designed in the form of robotics in the digital electronics course of D3 Informatics Management at the State University of Surabaya [18]; this module received a positive response from students (90%), who felt happy and motivated by using learning modules equipped with teaching aids in the learning process using an electronic module. Thus, the development of the electronic module is suitable for use in learning digital electronics courses.

The research results regarding the development of learning media in Basic Electricity and Electronics subjects are very feasible to use [19]. The media expert's assessment results are 0.84, and the material expert's assessment results are 0.74. Based on the two experts' assessments, the basic electronics module of electricity and electronics is very suitable for use in the learning process. The practical value of the teacher responses is 94%, and that of student responses is 84.24%. The post-test scores revealed that the students obtained effective results, namely 0.00, which was smaller than 0.005; this means that the scores of the experimental class and the control class were significant. This means that the instructional media design is very important and useful for the success of learning outcomes and students' abilities in the learning process.

6. Conclusions

Based on the research results regarding the development of learning media for the basic electronics practice module, it can be concluded that these learning media for the basic electronics practice module are suitable for use. The practical module design is made per the syllabus and the basic competencies required for basic electricity and electronics subjects. The making of the electronics practice module complies with a design that was validated by experts (material experts and media experts). In terms of the feasibility level, this electronics practice module is considered feasible.

From the research data, the feasibility value of the content assessment aspect by material experts is 92.50%. The construct validation aspect by media experts is 82.60%, and the feasibility value of the student usage assessment is 86.89%. The research results on the development of this electronics practice module can be used by students in all Vocational High Schools majoring in Audio-Video Engineering to support practicum activities, especially Basic Electrical and Electronics subjects, with a 100% success rate. The results of this study can also be applied significantly in Vocational High Schools in the Audio Video Engineering Department for Basic Electrical and Electronics subjects.

References

[1] RUSSEL, J.D., HEININCH R. & MOLENDA M. *Instructional Media and the New Technologies of Instruction,* 7th Edition USA: John Wiley & Sons. Inc., 2001.

[2] ISROK'ATUN I., HANAFIAH N., & SUJANA A. *Practicing Problem Posing Skills through Situation-Based Learning for Elementary School Students*. Bandung: UPI Sumedang Press, 2018.

[3] WIDHARYANTO. *Learning Models of Indonesian Language and Literature*. Teacher Professional Training Materials: Yogyakarta State University, 2008.

[4] ARSYAD, A. *Learning Media*. Jakarta: PT Raja Grafindo Persada, 2014.

[5] HAMID M.A., YULIAWATI, L. & ARIBOWO D. Feasibility of electromechanical basic work e-module as a new learning media for vocational students. *Journal of Education and Learning*, 2020, 14: 199-211. http://doi.org/10.11591/edulearn.v14i2.15923.

[6] NINGTYAS R.K. & JATI H. Project-Based Electronic Module Development as a Supporting Learning Media for Basic Programming Learning. *Journal of Educational Science and Technology*, 2018, 4(3): 221-227. http://dx.doi.org/10.26858/est.v1i1.6999

[7] PRASASTI F.D., SITUMORANG R., KUSUMAWARDANI D. Development of Integrated Audio-Visual Module for Learning Animation Principles at Multimedia Vocational School. *International Journal of Education, Information Technology, and Others*, 2018, 1(2): 55-69, https://doi.org/10.5281/zenodo.1795345

[8] REISER, R.A. & DICK W. *Instructional Planning: A Guide for Teachers.* 2nd Ed. USA: Allyn and Bacon, 1996.

[9] RAHAYU I., and SUKARDI S. A Needs Analysis for the Development of E-Modules Project-Based Learning. *Journal of Vocational Technology Education*, Special Issue, 2020, 3(1): 41-45, https://doi.org/10.24036/jptk.v3i1.3923

[10] HAMID M.A., ARIBOWO D. & DESMIRA D. Development of Learning Modules of Basic Electronics-Based Problem-Solving in Vocational Secondary School. *Journal of Vocational Education*, 2017, 7(2): 149-157, https://doi.org/10.21831/jpv.v7i2.12986

[11] GAGNE R.M. & BRIGGS L.J. *The Conditions of Learning.* 3rd Edition. USA: Holt, Rinehart and Winston, 1977.

[12] GAGNE R.M., BRIGGS L.J & WAGER W.W. *Principles of Instructional Design*. 4th ed. Fort Worth: Harcourt Brace Jovanovich College Publishers, 1992.

[13] GALL M.D, GALL J.P., & BORG, W.R. *Education Research: An Introduction,* 8th ed. Pearson, 2007

[14] SEELS, B.B., & RICHEY, R.C. Instructional technology: The definition and domains of the field. Washington, DC: Association for Educational Communications and Technology, 1994.

[15] HANNAFIN M.J., & PECK, K.L. *The Design, Development, and Evaluation of Instructional software*, 1st ed. Macmillan, 1988.
[16] SUGIYONO. *Educational Research Methods (Quantitative Approaches, Qualitative and R & D)*. Bandung: Alfabeta, 2015.
[17] RAHMI U., RAMADHAN S., & ASRI Y. Development of Electronic Module Hikayat Text Based on Project Based Learning (PJBL) Class X Students of High Schools. *Advances in Social Science, Education and Humanities Research*, 2019, 463: 32-37 http://doi.org/10.2991/assehr.k.200819.007
[18] HUDA S, BUDITJAHJANTO IGP. A., YUNDRA. E. Robotic Learning Media Development for D3 Students of Information Management Unesa. *Advances in Social Science, Education and Humanities Research*, 2019, 379: 206-213, https://doi.org/10.2991/assehr.k.191217.035
[19] SUMIATI M., RIZAL F., & ANWAR M. Development of Mobile-Learning Media on Basic Electricity and Electronics Subject. *Journal of Vocational Technology Education, Special Issue*, 2019, 3(1): 14-19. https://doi.org/10.24036/jptk.v3i1.3423

参考文:

[1] RUSSEL，J.D.，HEININCH R. 和 MOLENDA M. 教学媒体和教学新技术，美国第 7 版：约翰· 威利父子。公司，2001。
[2] ISROK'ATUN I.，HANAFIAH N. 和 SUJANA A. 通过基于情况的学习为小学生练习问题摆姿势的技巧。万隆：UPI 苏美当出版社，2018。
[3] WIDHARYANTO。印尼语言文学的学习模式。教师专业培训材料：日惹州立大学，2008。
[4] ARSYAD，A。学习媒体。雅加达：PT 拉贾· 格拉芬多· 佩萨达, 2014.
[5] HAMID M.A.，YULIAWATI，L。和 ARIBOWO D. 机电基础工作电子模块作为面向职业学生的新型学习媒体的可行性。教育与学习杂志，2020，14：199-211。http://doi.org/10.11591/edulearn.v14i2.15923。
[6] NINGTYAS R.K. 和 JATI H. 基于项目的电子模块开发，作为基础编程学习的支持学习媒体。教育科学与技术学报，2018，4（3）：221-227。http://dx.doi.org/10.26858/est.v1i1.6999
[7] PRASASTI F.D.，SITUMORANG R.，和 KUSUMAWARDANI D. 在多媒体职业学校开发用于学习动画原理的集成视听模块。国际教育，信息技术及其他杂志，2018，1（2）：55-69，https://doi.org/10.5281/zenodo.1795345
[8] REISER，R.A。和 DICK W. 教学计划：教师指南。第二版美国：艾琳和培根，1996。
[9] RAHAYU I. 和 SUKARDI S. 基于电子模块项目的学习发展的需求分析。职业技术教育学报，2020，3（1）：41-45，https://doi.org/10.24036/jptk.v3i1.3923
[10] HAMID M.A.，ARIBOWO D. 和 DESMIRA D. 在中等职业学校中开发基于基础电子学的问题解决学习模块。职业教育杂志，2017，7（2）：149-157，https://doi.org/10.21831/jpv.v7i2.12986
[11] GAGNE R.M. 和 BRIGGS L.J. 学习条件。第三版。美国：霍尔特，雷内哈特和温斯顿，1977。
[12] GAGNE R.M.，BRIGGS L.J. 和 WAGER W.W. 教学设计原理。第四版。沃思堡：哈科特· 布雷斯· 乔万诺维奇学院出版社，1992。
[13] GALL M.D，GALL J.P. 和 BORG，W.R。教育研究：简介，第 8 版。皮尔森，2007.
[14] SEELS，B.B. 和 RICHEY，R.C. 教学技术：领域的定义和领域。华盛顿特区：教育传播与技术协会，1994。
[15] HANNAFIN M.J. 和 PECK，K.L. 教学软件的设计，开发和评估，第一版。麦克米伦，1988。
[16] SUGIYONO。教育研究方法（定量方法，定性方法和研发方法）。万隆：阿尔法贝塔，2015。
[17] RAHMI U.，RAMADHAN S. 和 ASRI Y. 基于项目学习（PJBL）X 类高中生的佐贺电子模块文本的开发。社会科学，教育与人文研究进展，2019，463：32-37，http://doi.org/10.2991/assehr.k.200819.007
[18] HUDA S，BUDITJAHJANTO IGP。A.，云德拉。E. 信息管理大学 D3 学生的机器人学习媒体开发。社会科学，教育与人文科学进展，2019，379：206-213，https://doi.org/10.2991/assehr.k.191217.035
[19] SUMIATI M.，RIZAL F. 和 ANWAR M. 开发有关基础电力和电子学主题的移动学习媒体。职业技术教育学报，2019，3（1）：14-19。https://doi.org/10.24036/jptk.v3i1.3423