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Innovation in Vocational Learning: Project Based Learning E-Module on the Textile Dyeing Course

Mala Maulidina Pratiwi[1*], Waskito[2], Weni Nelmira[3], Ambiyar[4]
[1,2,3,4] Teknologi dan Kejuruan, Universitas Negeri Padang, Padang, Indonesia

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ABSTRAK

Permasalahan yang terjadi saat ini yaitu kurangnya sumber belajar inovatif yang dapat digunakan untuk belajar mandiri. Hal ini berdampak pada hasil belajar mahasiswa yang rendah. Tujuan penelitian ini yaitu mengembangkan E-modul berbasis Project Based Learning. Jenis penelitian ini yaitu penelitian pengembangan. Model yang digunakan untuk mengembangkan produk yaitu 4-D (pendefinisian, perancangan, pengembangan, dan penyebaran). Subjek penelitian yaitu 2 validator ahli materi, 3 validator ahli media, dan 2 validator ahli Bahasa. Subjek uji coba produk yaitu 16 mahasiswa yang diambil dalam dua kelas sebagai kelas control dan kelas eksperimen. Metode yang digunakan untuk mengumpulkan data yaitu observasi, wawancara, kuesioner, dan tes. Instrumen yang digunakan untuk mengumpulkan data yaitu lembar kuesioner dan soal tes. Teknik analisis data penelitian ini menggunakan analisis deskriptif kualitatif, kuantitatif, dan statistik inferensial. Hasil penelitian yaitu rata-rata penilaian validasi materi sebesar 0,86 dengan kategori Valid. Rata-rata hasil penilaian validasi E-modul dari segi media sebesar 0,85 dengan kategori Valid. Penilaian validasi bahasa sebesar 0,86 dengan kategori valid. Kepraktisan oleh dosen sebesar 91,67% dengan kategori sangat praktis dan mahasiswa sebesar 82,5% dengan kategori sangat praktis. E-Modul ini dinyatakan efektif dalam meningkatkan hasil belajar mahasiswa berdasarkan ketuntasan klasikal sebesar 94,73%, dan perolehan skor sebesar 0,71 dalam kategori tinggi. Disimpulkan bahwa E-modul layak digunakan dalam pembelajaran dan dapat meningkatkan hasil belajar mahasiswa.

ABSTRACT

The current problem is the lack of innovative learning resources that can be used for independent learning. This has an impact on low student learning outcomes. The aim of this research is to develop an E-module based on Project Based Learning. This type of research is development research.The model used to develop products is 4-D (definition, design, development and distribution). The research subjects were 2 material expert validators, 3 media expert validators, and 2 language expert validators. The product trial subjects were 16 students who were taken into two classes as a control class and an experimental class. The methods used to collect data are observation, interviews, questionnaires and tests. The instruments used to collect data were questionnaire sheets and test questions. This research data analysis technique uses descriptive qualitative, quantitative and inferential statistical analysis. The research results areThe average material validation assessment was 0.86 with the Valid category. The average result of the E-module validation assessment in terms of media is 0.85 with the Valid category. The language validation assessment was 0.86 in the valid category. Practicality by lecturers was 91.67% in the very practical category and students were 82.5% in the very practical category. This e-Module was declared effective in improving student learning outcomes based on classical completeness of 94.73%, and a score of 0.71 in the high category. It was concluded that E-modules are suitable for use in learning and can improve student learning outcomes.

1. INTRODUCTION

Currently, globalization is developing very rapidly so that the aim of education is not only to make the nation's life more intelligent, but generations are required to master various kinds of knowledge and skills (Chai & Kong, 2017; Malik, 2018; Siregar, 2020). This is in line with the demands of learning in the 21st century, which integrates priorities in knowledge, skills and attitudes as well as mastery of information and communication technology in the learning process (Faizin et al., 2023; Junedi et al., 2020; Oksa & Soenarto, 2020; Pertiwi et al., 2018; Prayogi, 2020; Rosnaeni, 2021). Therefore, learning activities must be carried out effectively in order to achieve national education goals and current developments. Teachers are required to be able to manage learning activities that provide stimulation so that students are able to understand learning in accordance with the demands of current educational goals (Nainggolan et al., 2021; Önür & Kozikoğlu, 2020; Rahayu et al., 2022; Sari & Siregar, 2020). Educators are required to be facilitators in learning activities. Educators must be able to develop learning materials, which are further confirmed through the Minister of National Education Regulation regarding process standards which include rules regarding learning process planning which require educators in educational

** Corresponding Author: Mala Maulidina Pratiwi: Malamaulidina5@gmail.com*

units to develop Semester Implementation Plans (RPS). One element of RPS is learning resources and learning media (Harahap, 2019; Masithoh et al., 2022; Muazzomi & Sofyan, 2021; Sutama et al., 2021).

However, the current problem is the lack of creative teaching materials that support student learning activities. This is reinforced by previous findings which reveal that there are still many teachers who have difficulty developing creative teaching materials in accordance with the demands of the times (Albana & Sujarwo, 2021; Dewi et al., 2019; Sriyanti et al., 2021; Triwahyuningtyas et al., 2020). Other research also confirms that the lack of creative teaching materials has an impact on students who feel bored while studying or students who cannot learn independently in class (Istuningsih et al., 2018; Rahayu, I., & Sukardi, 2021; Saraswati et al., 2019). This problem was also found at one of the State Universities. The results of interviews conducted with lecturers of vocational textile dyeing courses in the PKK Fashion Design department at Padang State University found similar problems. The results of the interview show that what is currently being used is teaching materials in the form of modules, but these have not been updated to date. The lecturer stated that updates to learning resources needed to be carried out because several additional courses did not have much material. The results of interviews conducted with students studying textile dyeing courses showed that the difficulty in learning textile dyeing was understanding the teaching materials provided by the lecturer. Students stated that when lecturers provide teaching materials, students are required to immediately understand it themselves, but in reality students find it difficult to understand the teaching materials provided by the lecturer.

Based on these problems, the solution offered is to develop innovative teaching materials that can help students learn. Teaching materials can determine the quality of learning carried out in the classroom and/or in the practice room/laboratory (Husada et al., 2020; Murod et al., 2021). Learning materials are reading materials, tools, as well as methods or techniques used in teaching and learning activities, aimed at ensuring that the educational communication information process between educators and students can take place in an effective and efficient manner (Rizki Umi Nurbaeti, 2019; Syaifullah & Izzah, 2019; Tafonao, 2018). The practical benefits of teaching materials are that they can clarify the presentation of messages/information, expedite and improve learning processes and outcomes, increase and direct students' attention, increase learning motivation, and teaching materials can overcome the limitations of the senses, space and time (Lepiyanto & Pratiwi, 2015; Muga & DNL, 2017; Sumarni et al., 2016). One of the teaching materials that can be used to increase student enthusiasm and knowledge is E-module.One of the characteristics of the E-Module is that it is adaptive, namely having developments in science and technology tailored to the needs of students (Fausih & Danang, 2015; Husada et al., 2020; Lepiyanto & Pratiwi, 2015; Muga & DNL, 2017; Murod et al., 2021; Sumarni et al., 2016).

Modules are facilities or tools as student teaching materials that contain material arranged systematically to help educators and students in the learning process which is used in the teaching and learning process independently, so that the learning objectives can be achieved (Laili et al., 2019; Murniyanto et al., 2022; Ramadhani et al., 2021). E-Modules are teaching materials in the form of modules that are prepared according to electronic format and are expected to increase students' motivation and interest in learning (Herawati, NS, & Muhtadi, 2018; Lepiyanto & Pratiwi, 2015; Muga & DNL, 2017; Sumarni et al., 2016). E-modules can be used as an effective, contemporary learning media and can be used anywhere and anytime because they involve information technology. Electronic modules can be used independently and can stimulate critical thinking (Linda et al., 2021; Rohmah et al., 2021).E-module is a form of presentation of teaching materials designed to help students be independent and assist students in achieving certain learning goals which have been arranged systematically into the smallest learning units (Andani, 2020; Rahmah et al., 2021). E-modules are presented in electronic format which includes text, images, audio, video, animation and interactive (Herawati, NS, & Muhtadi, 2018; Lepiyanto & Pratiwi, 2015; Muga & DNL, 2017; Sumarni et al., 2016). The electronic module contains operational work steps and work drawings as material that will be put into practice to create or complete a job. This can maximize understanding in efforts to form basic abilities (Laili et al., 2019; Murniyanto et al., 2022; Ramadhani et al., 2021). E-modules can help students to carry out practical activities and complete the practical assignments given.

E-modules need to be developed with a Project Based Learning approach to direct students to develop their thinking and have communication skills. Project Based Learning is a learning model that actively involves students in designing learning objectives to produce real products or projects (Laili et al., 2019; Rati et al., 2017; Yamin et al., 2020). Using the Project Based Learning model allows students to create products with their own work (Agung et al., 2022; Rusmini et al., 2021). Project Based Learning can increase creativity and critical thinking (Agung et al., 2022; Rusmini et al., 2021; Sumarmi et al., 2021; Sumarni & Kadarwati, 2020). This is closely related to the learning outcomes of textile dyeing courses which require students to be able to be responsible for their work in their field of expertise independently, to be able to think critically, intelligently and creatively.

Previous research findings stated that the use of E-modules can increase students' activeness in independent learning (Andani, 2020; Laili et al., 2019; Murod et al., 2021). Other research also confirms that E-modules can make it easier for students to learn because they are designed in an interesting and innovative way (Lestari & Parmiti, 2020; Putra et al., 2017; Simamora et al., 2019). Other research states that the Project Based

Learning approach can improve students' understanding and critical thinking skills (Insyasiska et al., 2017; Sumardiana et al., 2019; Susanto et al., 2020). Based on this, it can be concluded that the E-module approach based on Project Based Learning is an alternative in solving student learning problems. However, there has been no study regarding E-modules based on Project Based Learning in the Textile Coloring course of the PKK Fashion Design Study Program. The importance of this research is that Project Based Learning-based E-modules can facilitate students in learning, especially in the Textile Dyeing course so that students' abilities can increase. Based on this, the aim of this research is to develop an E-module based on Project Based Learning for the Textile Coloring course in the PKK Fashion Design Study Program. An electronic module based on Project Based Learning in the textile coloring course which can be used as teaching material for students and teaching staff or lecturers, and is expected to be able to become effective teaching material with full innovation, increasing students' ability to develop their creativity and way of thinking in accordance with learning outcomes.

2. METHOD

The type of research used in this research is development (Research and Development). The model used to develop electronic module products based on Project Based Learning in the textile coloring course is 4-D. The stages of the 4-D model are definition, design, development and deployment (Kurnita et al., 2022).The definition stage (Define) which includes the initial analysis stage (front-end-analysis), student analysis (learner analysis), task analysis (task analysis), concept analysis (concept analysis), and formulating learning objectives (specifying instructional objectives). The design stage includes the stage of constructing a benchmark reference test (constructing criterion-referenced test), the stage of selecting the media (media selection), selecting the format (format selection), and creating an initial design (initial design). The development stage includes expert appraisal and development testing. The deployment stage is the stage of product dissemination. The dissemination stage is carried out on a limited basis, namely by providing the product development results.

The research was conducted in the 3rd semester of the PKK fashion design study program, Faculty of Tourism and Hospitality, Padang State University. The research subjects were 2 material expert validators, 3 media expert validators, and 2 language expert validators. The product trial subjects were 16 students taken in two classes as a control class and an experimental class who took textile dyeing courses. The methods used to collect data are observation, interviews, questionnaires and tests. Observation and interview methods are used to obtain data regarding problems that occur in the field. The questionnaire method is used to collect data in the form of input and scores given by experts. The test method is used to collect data on student learning outcomes after implementing Project Based Learning-based electronic module products. The instruments used to collect data were questionnaire sheets and test questions. The research instrument grid is presented in Table 1 and Table 2.

Table 1. The Validity Instrument Grid for Material Experts

No	Validation Aspect	Indicator
1	Material aspect	1. Conformity between learning outcomes and material
		2. Compatibility of material with KD
		3. Material is easy to understand
		4. Material in complete learning media
2	Language aspect	1. Use of EYD
		2. Use clear, simple and easy to understand sentences
		3. The terms used are appropriate to the material
3	Learning aspect	1. e-modules support students' independent learning
		2. Clarity and orderliness of the material presented
		3. Feedback on the module is available
		4. The module gives students the opportunity to measure understanding of the material

Table 2. The Media Expert Instrument Validation Grid

No	Validation Aspect	Indicator
1	Appearance	1. Suitability of media with teaching material
		2. Color displays, images, pages, videos and evaluations
		3. Appearance of the cover, material sheet, and clarity of appearance
2	Legibility	1. Ease of access and navigation
		2. Ease of operation
3	Use	1. Ease of independent learning
		2. The media follows developments in science and technology

No	Validation Aspect	Indicator
4	Language	1. Use of EYD 2. The language used in teaching materials is easy to understand

This research data analysis technique uses descriptive qualitative, quantitative and inferential statistical analysis. Validity data were analyzed using the Aiken's V validity coefficient. Data analysis was assisted using the SPSS version 26.0 application. Practicality analysis was carried out after all questionnaires were filled in by students and educators. Analysis of the effectiveness of the e-module was carried out after field trials and student learning outcomes were obtained through work assessment rubrics. A class is said to have completed its learning (classical completeness) if in that class there are ≥ 85% of students who have completed their learning. Effectiveness is reviewed based on the Gain Score. This analysis was carried out to determine the impact of using Project Based Learning based E-modules in terms of student learning outcomes and seen from the increase in learning outcomes before using Project Based Learning based E-modules and after use. The first step is that the test subjects are given an initial test (pre-test) and a final test (post-test).

3. RESULT AND DISCUSSION

Result

This research was carried out with the aim of producing a Project Based Learning-based E-Module that is valid, practical and effective with the 4D stage. There are 4 stages in developing Project - Based Learning-based E-Modules including the define, design, develop and disseminate stages. First, the define stage. The define stage is carried out with the aim of obtaining an overview of learning conditions. At this stage, a needs analysis is carried out which aims to determine the creation of a Project Based Learning-based learning E-module in the textile dyeing course. Various analyzes are carried out at this stage including needs analysis, student analysis, concept analysis, and formulation of learning objectives. The results of the needs analysis are based on observations made at Padang State University in the textile coloring course, the media used by lecturers in learning is still simple, such as handout sheets and PowerPoint. So far, learning in textile coloring courses is still less effective, interactive and tends to be monotonous. In addition, currently the conditions that occur due to the change of learning location in the fashion design department, especially textile coloring, the classes used are not conducive. So students must carry out further understanding and independent practicum at home. The media used does not support independent learning. The results of the analysis of student characteristics are students with various characteristics. This can be found in the ongoing teaching and learning process, for example, there are students who ask the lecturer when they are confused about learning. Based on this analysis, it is necessary to have a learning approach that is able to encourage students to be active and independent in the textile coloring learning process. The results of the RPS analysis are learning outcomes in the textile coloring course, namely that students are able to understand and master knowledge and skills in the field of dyeing textile materials, students are able to think intelligently, critically and creatively. Based on these learning outcomes, learning is needed that can accommodate students to achieve the expected goals. The learning outcomes of the textile coloring course are related to the characteristics of the Project Based Learning approach. Therefore, the results of the RPS analysis of the textile coloring course showed that the material was in accordance with the competencies that students had to achieve.

Second, the design stage. The design stage aims to develop learning media which begins with creating a product development design and the aim of the design stage is to design a systematic module writing format and the resulting modules are in accordance with the needs of students. The activities carried out in the design stage produce the following product design: a) media selection, this research chooses an E-module product based on Project Based Learning. b) Format selection, this E-module format is designed to be accessed using a smartphone or laptop. c) Initial selection of E-module. The initial stage is selecting the color of the E-Module to be designed. Choosing the right color will make the product design of the E-Module more communicative and aesthetic. The choice of color in designing teaching materials can arouse and stimulate the thoughts, attention and will of students.

Third, development stage. Development is carried out to obtain valid, practical and effective E-Modules. This stage in development includes the validity testing stage obtained from the validator assessment. In making this E-module, it was designed using the Flipbook Maker software. The development of this Emodule can be used as a learning medium that can be accessed via laptop and smartphone. This E-module format uses flipbook Maker software which can be accessed on smartphones and laptops. The use of flipbooks can be accessed wherever and whenever students are. Preparation of the E-Module display design framework which includes cover, foreword, table of contents, list of images and table list, module description, how to use the module, course RPS, Project Based Learning syntax, material concept map, materials, assessment or evaluation, list library and glossary. The results of the development of E-Modules based on Project Based Learning are presented in Figure 1.

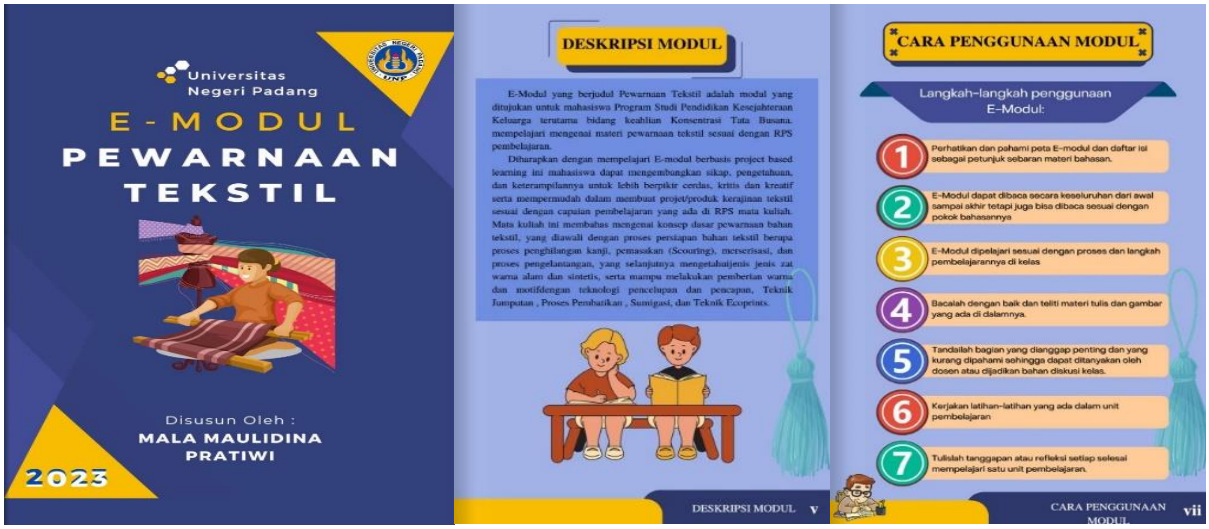

Figure 1. The Results of E-Module Development based on Project Based Learning

The Project Based Learning-based e-Module that was developed later was tested for validity by experts. The assessment results from the E-module material validator test in the textile coloring course consisted of 2 experts, with an average of 0.85. The results of material validation regarding the E-Module for textile coloring based on Project Based Learning by experts were 0.85 > 0.66, so the learning E-Module was categorized as materially valid. Results of the E-module media validator test assessment based on Project Based Learning for the textile coloring course consisting of three experts. It was concluded that the learning E-Module was categorized as valid. The results of the product validity test according to experts are presented in Table 3**.**

Table 3. The Validity Results of E-module Based on Project Based Learning for Textile Dyeing Course

No	Validity Test Data	Average value	Category
1	Validity of the E-module Material for the Textile Dyeing Course	0.85	Valid
2	Validity of the E-module Media for the Textile Dyeing Course	0.86	Valid
3	Validity of the E-Module Language for the Textile Dyeing Course	0.86	Valid
	Average value	**0.856**	**Valid**

Based on Table 3 The results of the media validity test by media experts on the Project Based Learning-based textile coloring E-Module obtained a validation value of 0.86 > 0.66, so the learning E-Module was declared valid. The results of the E-module language validator test assessment based on Project Based Learning for the textile coloring course consisted of 2 experts, namely 0.86. The results of language validation by linguists for the Project Based Learning-based textile coloring E-Module were 0.86 > 0.66. The overall average score was 0.86. E-module based on Project Based Learning Textile Dyeing Course which has been valid is then tested for practicality by lecturers and students. An analysis of the effectiveness of the Project Based Learning E-Module for the textile coloring course was carried out with the aim of determining the level of effectiveness of the E-Module that has been applied in the learning process. The results of students' classical completion are presented in Table 4.

Table 4. The Validity Results of E-module Based on Project Based Learning for Textile Dyeing Course

Activity	Maximum Value	Minimum Value	Complete ≥ 85%	%	Information
Pretest	80	35	8	42.10%	Not Completed
Post-test	90	65	18	94.73%	Complete

Based on Table 4, the results of completing the questionnaire carried out by the lecturer showed that the practicality of the E-Module learning based on Project Based Learning for the textile coloring course was an overall average of 91.67. The results of the lecturer's practicality in the E-module for learning the textile coloring course based on Project Based Learning, namely with very practical interpretation. The assessment results given by students regarding the Project Based Learning E-module for the Textile Dyeing Course were 82.5. Results of student assessment of the level of practicality of the E-Module in the Project Based Learning-based textile coloring course in the practical category.

The E-Module based on Project Based Learning for textile coloring is said to be effective. The N-gain score is carried out with the aim of effectively using a method or treatment in one group pretest posttest research. The Ngain test score is calculated from the difference between the pretest and posttest scores. The results of the N-gain score test are presented in Table 5.

Table 5. The Effectiveness Results Based on Gain Score Value

N	X	Minimum Score Gain	Maximum Score Gain	Average Score	Category
19	X_1	0.55	1.00	0.71	Tall
19	X_2	0.13	0.71	0.44	Currently

Based on Table 5, the results of the analysis obtained an average student completion rate of 94.73%. This shows that classical completeness has been achieved. It can be concluded that the E-Module based on Project Based Learning in the textile coloring course is effective when viewed from classical completeness. The gain score value can be seen from the amount of increase in student learning outcomes after the pretest and posttest. From the data above, it can be concluded that the NGain Score test calculation of student learning outcomes in the experimental class with an average of 0.71 can be categorized as high with a minimum Gain Score value of 0.55 and a maximum Gain Score value of 1. Meanwhile, the control class produces average learning outcomes. -The average N-Gain Score of 0.44 can be categorized as medium, the minimum Gain Score value is 0.13 and the maximum value is 0.71. So from these two results it can be interpreted that the use of E-Modules based on Project Based Learning in teaching textile coloring has been developed more effectively in improving student learning outcomes.

Fourth, distribution. The E-Module developed has obtained valid, practical and effective results, so the learning E-Module can be said to be suitable for distribution. E-Modules that are ready to be distributed can also be used by other classes who are studying the same course. The distribution is carried out through lecturers who teach textile coloring courses so that it can be applied in the learning process. This distribution stage was carried out with the aim of finding out the feasibility of using learning media by lecturers and students, so that this Project Based Learning-based E-Module can be used as part of a tool that can be used to improve student learning outcomes through quality learning. The design of this E-Module is carried out according to the deployment stage.

Discussion

The results of data analysis show that the Project Based Learning E-Module for the textile coloring course received valid and very practical qualifications from experts, lecturers and students. This is caused by several factors, namely as follows. First, Project Based Learning-based learning e-modules are suitable for use in learning because they can improve learning outcomes. E-Modules are facilities or tools as teaching materials that contain material arranged systematically so that it makes learning easier (Laili et al., 2019; Murod et al., 2021; Rohmah et al., 2021). Students who are easy to learn will certainly have an impact on increased learning outcomes so that the goals of learning can be achieved. The characteristic of the E-Module is that it is adaptive, that is, it has developments in science and technology adapted to the needs of students (Fausih & Danang, 2015; Linda et al., 2021). This is what allows students to study anywhere, resulting in increased learning outcomes. Apart from that, the learning E-Module was developed using a Project Based Learning approach. The Project Based Learning learning model has characteristics that make students become facilitators, and provides problems in the form of projects that students must complete (Agung et al., 2022; Sukmara, 2021; Wijayanti et al., 2020). This certainly has an impact on students' increasing understanding.

Second, Project Based Learning-based learning e-modules are suitable for use in learning because they can increase enthusiasm for learning. E-Modules are teaching materials in the form of modules arranged in electronic format so as to increase motivation in learning (Herawati, NS, & Muhtadi, 2018; Laili et al., 2019; Murod et al., 2021; Rohmah et al., 2021). The learning media used can foster interest in learning due to innovation, an attractive appearance that makes you more enthusiastic and ultimately learning outcomes increase (Sriyanti et al., 2021; Sukarman et al., 2021; Triwahyuningtyas et al., 2020). Project Based Learning-based e-modules will provide text that is easy to understand, as well as images that are more interesting and real according to the material being studied so that they can help students remember the learning more easily (Albana & Sujarwo, 2021; Saraswati et al., 2019). Apart from that, there are learning videos in the E-Module which can add to students' references and insight into the material being studied so as to help students in solving problems they face related to learning material on textile coloring in everyday life.

Third, Project Based Learning-based learning e-modules are suitable for use in learning because they can improve the atmosphere for independent learning. E-Modules have a display that involves images, audio, video and animation to function as independent teaching materials (Rahayu, I., & Sukardi, 2021; Saraswati et al., 2019; Sriyanti et al., 2021). This can create a pleasant learning atmosphere (Andermi & Eliza, 2021; Hastuti et al., 2020; Ramadhani et al., 2021). This e-learning module is a learning program package created for students and can be

used independently wherever and whenever they are. E-Modules have self-contained characteristics if all the required learning material is contained in the module (Aprilia & Suryadarma, 2020; Ilmi et al., 2021). The aim of this concept is to provide an opportunity to study the learning material completely, because the learning material is packaged into one complete unit. With the E-module, students can practice their abilities by doing the exercises presented in the module.

Previous research findings also state that E-modules are useful for reducing dependence on the availability of other teaching materials (Asmi et al., 2018; Wahidah et al., 2019). Other research also states that E-modules can be interesting learning because they can be studied outside of class and outside of learning hours (Albana & Sujarwo, 2021; Hamzah & Mentari, 2017; Saraswati et al., 2019). Other research also states that the use of Project Based Learning can improve learning outcomes (Masruri, 2018; Pratiwi et al., 2018; Wijanarko et al., 2017). It can be concluded that Project Based Learning E-Modules can use student learning outcomes. The advantage of the Project Based Learning e-module is that it presents variants such as images, audio, video and animation, making it easier for students to understand the learning material. The limitation of this research is that the development of an E-Module based on Project Based Learning can only be used in textile dyeing courses. Apart from that, the trials carried out are still within the limits of limited trials, and have not yet carried out widespread trials. The implication of this research is that the application of E-Modules based on Project Based Learning can help improve learning outcomes in textile coloring courses. Project Based Learning e-learning modules increase student enthusiasm and activeness in independent learning.

4. CONCLUSION

The results of data analysis show that the Project Based Learning E-Module for the textile coloring course received valid qualifications from experts. The results of the practicality analysis also show that the Project Based Learning E-Module for the textile dyeing course received very practical qualifications from lecturers and students. The results of the NGain Score test calculation show that student learning outcomes in the experimental class are categorized as high. Meanwhile, the control class produces learning outcomes in the low category. It was concluded that the use of E-Modules based on Project Based Learning in teaching textile coloring was developed more effectively in improving student learning outcomes.

5. REFERENCES

Agung, A. A. G., Basilius Redan Werang, & Anak Agung Putri Sri. (2022). Project-Based E-Learning and Its Impact on Students' Academic Achievement in Curriculum Development Lectures. *Mimbar Ilmu*, *27*(3), 362–369. https://doi.org/10.23887/mi.v27i3.53855.

Albana, L. F. A. N. F., & Sujarwo, S. (2021). An interactive e-module develompent to increase the self-regulated learning of basic graphic design. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *5*(2). https://doi.org/10.21831/jk.v5i2.33278.

Andani, M. (2020). E-Modul Fisika Dasar I Berbasis 3D Pageflip Professional. *Schrodinger Journal of Physics Education*, *1*(2), 44–47. https://doi.org/10.37251/sjpe.v1i2.79.

Andermi, A. D., & Eliza, F. (2021). Pengembangan E-Modul Pembelajaran Instalasi Penerangan Listrik di Sekolah Menengah Kejuruan. *Jurnal Pendidikan Teknik Elektro*, *2*(2), 24–27. https://doi.org/10.24036/jpte.v2i2.101.

Aprilia, I., & Suryadarma, I. G. P. (2020). E-module of mangrove ecosystem (emme): development, validation and effectiveness in improving students' self-regulated. *Biosfer: Jurnal Pendidikan Biologi*, *13*(1), 114–129. https://doi.org/10.21009/biosferjpb.v13n1.114-129.

Asmi, A. R., Dhita Surbakti, A. N., & Hudaidah. (2018). E-Module Development Based Flip Book Maker For Character Building In Pancasila Coursework Sriwijaya University. *Jurnal Pendidikan Ilmu Sosial*, *27*(1), 1–10. https://doi.org/10.17509/jpis.v27i1.9395.

Chai, C. S., & Kong, S.-C. (2017). Professional learning for 21st century education. *Journal of Computers in Education*, *4*(1), 1–4. https://doi.org/10.1007/s40692-016-0069-y.

Dewi, Masril, M., Naf'an, E., Hendrik, B., Veri, J., Munawwaroh, K., Silfia, E., & Widyatama, A. (2019). The Development of E-Module English Specific Purpose based on Computer Application for Vocational High School Students. *Journal of Physics: Conference Series*, *1364*(1). https://doi.org/10.1088/1742-6596/1364/1/012043.

Faizin, M., Rahman, R. N., Labibah, S., Saharani, V. A., & Nabila, A. N. (2023). Keterampilan Pendidik Abad 21 dalam Mengaplikasikan Pendekatan Student Centered Learning pada Mata Pelajaran Pendidikan Agama Islam. *EL-BANAT: Jurnal Pemikiran Dan Pendidikan Islam*, *13*(1), 1–22. https://doi.org/10.54180/elbanat.2023.13.1.1-22.

Fausih, M., & Danang, T. (2015). Pengembangan Media E-Modul Mata Pelajaran Produktif Pokok Bahasan

"Instalasi Jaringan Lan (Local Area Network)" Untuk Siswa Kelas Xi Jurusan Teknik Komputer Jaringan Di Smk Nengeri 1 Labang Bangkalan Madura. *Jurnal UNESA*, *01*(01), 1–9. https://ejournal.unesa.ac.id/index.php/jmtp/article/view/10375.

Hamzah, I., & Mentari, S. (2017). Development of Accounting E-Module to Support the Scientific Approach of Students Grade X Vocational High School. *Journal of Accounting and Business Education*, *1*(1), 78–88. https://doi.org/10.26675/jabe.v1i1.9751.

Harahap, N. J. (2019). Mahasiswa dan Revolusi Industri 4.0. *Ecobisma (Jurnal Ekonomi, Bisnis Dan Manajemen)*, *6*(1), 70–78. https://doi.org/10.36987/ecobi.v6i1.38.

Hastuti, P., Thohiri, R., & Panggabean, Y. (2020). Pengembangan E-Module Berbasis Problem Based Learning Mata Pelajaran Ekonomi Kelas X SMA Negeri 1 Percut Sei Tuan Tahun Ajaran 2018/2019. *PEMBELAJAR: Jurnal Ilmu Pendidikan, Keguruan, Dan Pembelajaran*, *4*(2), 60. https://doi.org/10.26858/pembelajar.v4i2.13559.

Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA. *Jurnal Inovasi Teknologi Pendidikan*, *5*(2), 180–191. https://doi.org/10.21831/jitp.v5i2.15424.

Husada, S. P., Taufina, T., & Zikri, A. (2020). Pengembangan Bahan Ajar Pembelajaran Tematik dengan Menggunakan Metode Visual Storytelling di Sekolah Dasar. *Jurnal Basicedu*, *4*(2), 419–425. https://doi.org/10.31004/basicedu.v4i2.373.

Ilmi, R., Arnawa, I. M., Yerizon, & Bakar, N. N. (2021). Development of an Android-Based for Math E-Module by using Adobe Flash Professional CS6 for Grade X Students of Senior High School. *Journal of Physics: Conference Series*, *1742*(1). https://doi.org/10.1088/1742-6596/1742/1/012026.

Insyasiska, D., Zubaidah, S., & Susilo, H. (2017). Pengaruh project based learning terhadap motivasi belajar, kreativitas, kemampuan berpikir kritis, dan kemampuan kognitif siswa pada pembelajaran biologi. ,. *Jurnal Pendidikan Biologi*, *7*(1), 9–21. https://doi.org/10.17977/um052v7i1p9-21.

Istuningsih, W., Baedhowi, & Sangka, K. B. (2018). The effectiveness of scientific approach using e-module based on learning cycle 7e to improve students' learning outcome. *International Journal of Educational Research Review*, *3*(3). https://doi.org/10.24331/ijere.449313.

Junedi, B., Mahuda, I., & Kusuma, J. W. (2020). Optimalisasi keterampilan pembelajaran abad 21 dalam proses pembelajaran pada Guru MTs Massaratul Mut'allimin Banten. *Transformasi: Jurnal Pengabdian Masyarakat*, *16*(1), 63–72. https://doi.org/10.20414/transformasi.v16i1.1963.

Kurnita, T., Mutmainnah, M., Nessa, R., Kurniawati, R., Muna, Z., Fanny, N., Wahyuni, I. W., Rizka, S. M., Arta, K. H., & Yunisari, D. (2022). Pengembangan Bahan Ajar Berbasis Budaya Aceh Untuk Pendidikan Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(4), 3793–3806. https://doi.org/10.31004/obsesi.v6i4.1699.

Laili, I., Ganefri, & Usmeldi. (2019). Efektivitas Pengembangan E-Modul Project Based Learning Pada Mata Pelajaran Instalasi. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *3*(3), 306–315. https://doi.org/10.23887/jipp.v3i3.21840.

Lepiyanto, A., & Pratiwi, D. (2015). Pengembangan Bahan Ajar Berbasis Inkuiri Terintegrasi Nilai Karakter Peduli Lingkungan Pada Materi Ekosistem. *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *6*(2), 143–147. https://doi.org/10.24127/bioedukasi.v6i2.344.

Lestari, H. D., & Parmiti, D. P. P. P. (2020). Pengembangan E-Modul IPA Bermuatan Tes Online Untuk Meningkatkan Hasil Belajar. *Journal of Education Technology*, *4*(1), 73–79. https://doi.org/10.23887/jet.v4i1.24095.

Linda, R., Zulfarina, Mas'ud, & Putra, T. P. (2021). Peningkatan Kemandirian dan Hasil Belajar Peserta Didik Melalui Implementasi E-Modul Interaktif IPA Terpadu Tipe Connected Pada Materi Energi SMP/MTs. *Jurnal Pendidikan Sains Indonesia*, *9*(2), 191–200. https://doi.org/10.24815/jpsi.v9i2.19012.

Malik, R. S. (2018). Educational challenges in 21st century and sustainable development. *Journal of Sustainable Development Education and Research*, *2*(1), 9–20. https://doi.org/10.17509/jsder.v2i1.12266.

Masithoh, S., Miftah, H., Nahraeni, W., Yoesdiarty, A., Novita, I., Agribisnis, P., Pertanian, F., & Djuanda, U. (2022). Implementasi Mbkm (Merdeka Belajar Kampus Merdeka) Menurut Perspektif Mahasiswa Agribisnis. *Jurnal Agribisains*, *7*(2), 59–67. https://doi.org/10.30997/jagi.v7i2.5036.

Masruri, M. (2018). Metode Simulasi Berbasis Project Based Learning Sebagai Alternatif Upaya Meningkatkan Motivasi Dan Hasil Belajar Konsep Mutasi Pada Siswa Kelas Xii Mipa Sma Negeri 1 Moga Tahun Pelajaran 2019/2020. *Perspektif Pendidikan Dan Keguruan*, *11*(1). https://doi.org/10.25299/perspektif.2020.vol11(1).4588.

Muazzomi, N., & Sofyan, H. (2021). Pengembangan Bahan Ajar Pengembangan APE Berbasis Kewirausahaan S1 PG- PAUD FKIP Universitas Jambi. *Jurnal Sains Sosio Humaniora*, *5*(2), 742–749. https://doi.org/10.22437/jssh.v5i2.15780.

Muga, W., & D.N.L., L. (2017). Pengembangan Bahan Ajar Elektronik Berbasis Model Problem Based Learning

Dengan Menggunakan Model Dick And Carey. *Journal of Education Technology*, *1*(4), 260–264. https://doi.org/10.23887/jet.v1i4.12863.

Murniyanto, M., Gusmuliana, P., Rahmaningsih, S., Apriani, E., Astari, R., Indriani, R., & Puspitasari, W. (2022). The development of Islamic moderation-based English e-modules towards a high quality IAIN Curup. *AL-ISHLAH: Jurnal Pendidikan*, *14*(3), 3729–3742. https://doi.org/10.35445/alishlah.v14i3.1878.

Murod, M., Utomo, S., & Utaminingsih, S. (2021). Efektivitas Bahan Ajar E-Modul Interaktif Berbasis Android Untuk Peningkatan Pemahaman Konsep Lingkaran Kelas VI SD. *Fenomena*, *20*(2), 219–232. https://doi.org/10.35719/fenomena.v20i2.61.

Nainggolan, M., Tanjung, D. S., & Simarmata, E. J. (2021). Pengaruh Model Pembelajaran SAVI terhadap Hasil Belajar Matematika Siswa di Sekolah Dasar. *Jurnal Basicedu*, *5*(4), 2617–2625. https://doi.org/10.31004/basicedu.v5i4.1235.

Oksa, S., & Soenarto, S. (2020). Pengembangan e-modul berbasis proyek untuk memotivasi belajar siswa sekolah kejuruan. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *4*(1), 99–111. https://doi.org/10.21831/jk.v4i1.27280.

Önür, Z., & Kozikoğlu, İ. (2020). The Relationship between 21 st Century Learning Skills and Educational Technology Competencies of Secondary School Students. *Journal of Theoretical Educational Science*, *13*(1), 65–77. https://doi.org/10.30831/akukeg.535491.

Pertiwi, U. D., Atanti, R. D., & Ismawati, R. (2018). Pentingnya Literasi Sains Pada Pembelajaran IPA SMP Abad 21. *Indonesian Journal of Natural Science Education (IJNSE)*, *1*(1), 24–29. https://doi.org/10.31002/nse.v1i1.173.

Pratiwi, I. A., Ardianti, S. D., & Kanzunnudin, M. (2018). Peningkatan Kemampuan Kerjasama Melalui Model Project Based Learning (PjBL) Berbantuan Metode Edutainment Pada Mata Pelajaran Ilmu Pengetahuan Sosial. *Refleksi Edukatika : Jurnal Ilmiah Kependidikan*, *8*(2). https://doi.org/10.24176/re.v8i2.2357.

Prayogi, R. D. (2020). Kecakapan abad 21: Kompetensi digital pendidik masa depan. *Manajemen Pendidikan*, *14*(2). https://doi.org/10.23917/jmp.v14i2.9486.

Putra, K. W. B., Wirawan, I. M. A., & Pradnyana, G. A. (2017). Pengembangan E-Modul Berbasis Model Pembelajaran Discovery Learning Pada Mata Pelajaran "Sistem Komputer" Untuk Siswa Kelas X Multimedia SMK Negeri 3 Singaraja. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *14*(1). https://doi.org/10.23887/jptk-undiksha.v14i1.9880.

Rahayu, I., & Sukardi, S. (2021). The Development Of E-Modules Project Based Learning for Students of Computer and Basic Networks at Vocational School. *Journal of Education Technology*, *4*(4), 398–403. https://doi.org/10.23887/jet.v4i4.29230.

Rahayu, R., Iskandar, S., & Abidin, Y. (2022). Inovasi pembelajaran abad 21 dan penerapannya di Indonesia. *Jurnal Basicedu*, *6*(2), 2099–2104. https://doi.org/10.31004/basicedu.v6i2.2082.

Rahmah, N. A., Fadilah, S. R. N., & Ratnaningsih, N. (2021). Pengembangan E-Modul FLIPHTML Bangun Ruang Sisi Datar berbasis Cerita Bergambar. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *3*(2), 166–173. https://doi.org/10.26877/imajiner.v3i2.7991.

Ramadhani, R., Mazaly, M. R., & Setiawati, T. (2021). Pengembangan E-Modul Berbasis EPUB3 Sigil dalam Meningkatkan Kemampuan Techno-Pedagogical Guru Sekolah Menengah. *JMM (Jurnal Masyarakat Mandiri)*, *5*(3), 1024–1039. https://doi.org/10.31764/jmm.v5i3.5003.

Rati, N. W., Kusmaryatni, N., & Rediani, N. (2017). Model Pembelajaran Berbasis Proyek, Kreativitas dan Hasil Belajar Mahasiswa. *JPI : Jurnal Pendidikan Indonesia*, *6*(1), 60–71. https://doi.org/10.23887/jpi-undiksha.v6i1.9059.

Rizki Umi Nurbaeti. (2019). Pengembangan Bahan Ajar Ipa Berbasis Problem Based Learning Untuk Siswa Kelas V Sekolah Dasar. *Jurnal Cakrawala Pendas*, *5*(1), 53–75. https://doi.org/10.31949/jcp.v5i1.1233.

Rohmah, F., Amir, Z., & Zulhidah. (2021). Pengembangan E-Modul Interaktif Berbasis Kontekstual pada Materi Volume Bangun Ruang SD/MI. *Jurnal Basicedu*, *5*(6), 6349_6356. https://doi.org/10.31004/basicedu.v6i2.2262.

Rosnaeni, R. (2021). Karakteristik dan Asesmen Pembelajaran Abad 21. *Jurnal Basicedu*, *5*(5), 4341–4350. https://doi.org/10.31004/basicedu.v5i5.1548.

Rusmini, Suyono, & Agustini, R. (2021). Analysis of science process skills of chemical education students through self-project based learning (sjbl) in the covid-19 pandemic era. *Journal of Technology and Science Education*, *11*(2), 371–387. https://doi.org/10.3926/jotse.1288.

Saraswati, S., Linda, R., & Herdini, H. (2019). Development of Interactive E-Module Chemistry Magazine Based on Kvisoft Flipbook Maker for Thermochemistry Materials at Second Grade Senior High School. *Journal of Science Learning*, *3*(1), 1–6. https://doi.org/10.17509/jsl.v3i1.18166.

Sari, S. P., & Siregar, E. F. S. (2020). Pengaruh Model Pembelajaran Abad 21 4Cs Dalam Meningkatkan Keterampilan Membuat Pertanyaan Tingkat Tinggi Mahasiswa PGSD FKIP Pada Materi Gejala Alam TA 2019/2020. *Jurnal Ilmiah Aquinas*, *3*(2), 208–215.

http://ejournal.ust.ac.id/index.php/Aquinas/article/download/720/pdf1.

Simamora, A. H., Sudarma, I. K., & Prabawa, D. G. A. P. (2019). Pengembangan E-Modul Berbasis Proyek Untuk Mata Kuliah Fotografi Di Jurusan Teknologi Pendidikan Fakultas Ilmu Pendidikan Undiksha. *Journal of Education Technology*, *2*(1), 51. https://doi.org/10.23887/jet.v2i1.13809.

Siregar, R. A. (2020). The Effective 21st-century Pedagogical Competence as Perceived by Pre-service English Teachers. *Pedagogy : Journal of English Language Teaching*, *8*(1), 1. https://doi.org/10.32332/pedagogy.v8i1.1953.

Sriyanti, I., Almafie, M. R., Marlina, L., & Jauhari, J. (2021). The effect of Using Flipbook-Based E-modules on Student Learning Outcomes. *Kasuari: Physics Education Journal (KPEJ)*, *3*(2), 69–75. https://doi.org/10.37891/kpej.v3i2.156.

Sukarman, Rahayu, W., & Hakim, L. El. (2021). The Effectiveness of Mathematics E-Modules with a Contextual Approach on Geometry Matters to Improving Students' Learning Outcomes. *Jurnal Pendidikan Indonesia (JPI)*, *10*(2), 362–369. https://doi.org/10.23887/jpi-undiksha.v10i2.33530.

Sukmara, R. (2021). Project Based Learning (PBL) Implementation For Improving japanese Language Grammar Competence in Virtual Classroom. *Japanedu*, *06*(01), 83–88. https://doi.org/10.17509/japanedu.v6i1.29746.

Sumardiana, S., Hidayat, A., & Parno, P. (2019). Kemampuan Berpikir Kritis pada Model Project Based Learning disertai STEM Siswa SMA pada Suhu dan Kalor. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(7), 874. https://doi.org/10.17977/jptpp.v4i7.12618.

Sumarmi, S., Bachri, S., Irawan, L. Y., Aliman, M., & Ahmad, W. I. W. (2021). Project-Based Research Learning (PBRL) Integrated With E-Learning in Projects Completion. *International Journal of Emerging Technologies in Learning*, *16*(7), 16–31. https://doi.org/10.3991/ijet.v16i07.21193.

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, *9*(1), 11–21. https://doi.org/10.15294/jpii.v9i1.21754.

Sumarni, W., Wardani, S., Sudarmin, S., & Gupitasari, D. N. (2016). Project based learning (PBL) to improve psychomotoric skills: A classroom action research. *Jurnal Pendidikan IPA Indonesia*, *5*(2). https://doi.org/10.15294/jpii.v5i2.4402.

Susanto, E., Susanta, A., & Rusdi. (2020). Efektivitas Project Based Learning Terhadap Kemampuan Pemecahan Masalah Dan Berpikir Kritis Mahasiswa. *Jurnal THEOREMS (The Original Research of Mathematics)*, *5*(1), 61. https://doi.org/10.31949/th.v5i1.2219.

Sutama, I. W., Astuti, W., & Anisa, N. (2021). E-Modul Strategi Pembelajaran Anak Usia Dini Sebagai Sumber Belajar Digital. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(3), 449. https://doi.org/10.23887/paud.v9i3.41385.

Syaifullah, M., & Izzah, N. (2019). Kajian Teoritis Pengembangan Bahan Ajar Bahasa Arab. *Arabiyatuna : Jurnal Bahasa Arab*, *3*(1), 127–144. https://doi.org/10.29240/jba.v3i1.764.

Tafonao, T. (2018). Peranan Media Pembelajaran Dalam Meningkatkan Minat Belajar Mahasiswa. *Jurnal Komunikasi Pendidikan*, *2*(2), 103. https://doi.org/10.32585/jkp.v2i2.113.

Triwahyuningtyas, D., Ningtyas, A. S., & Rahayu, S. (2020). The problem-based learning e-module of planes using Kvisoft Flipbook Maker for elementary school students. *Jurnal Prima Edukasia*, *8*(2), 199–208. https://doi.org/10.21831/jpe.v8i2.34446.

Wahidah, N. I., Ibrahim, N., & Muslim, S. (2019). E-module: Design a learning material with rowntree and hannafin model for higher education. *International Journal of Scientific and Technology Research*, *8*(12), 3373–3376. http://www.hillpublisher.com/UpFile/202103/20210322173949.pdf.

Wijanarko, Supardi, & Marwoto. (2017). Keefektifan Model Project Based Learning Terbimbing untuk Meningkatkan Keterampilan Proses Sains dan Hasil Belajar IPA. *Journal of Primary Education*, *6*(2), 120–125. https://doi.org/10.15294/jpe.v6i2.17561.

Wijayanti, N., Wahyuningsih, D., & Rahardjo, D. T. (2020). Pengembangan E-Modul Praktikum Listrik Magnet Pada LMS Moodle Di Laman Spada UNS Dengan Model Inkuiri Terbimbing. *Jurnal Materi Dan Pembelajaran Fisika*, *10*(2), 115–121. https://doi.org/10.20961/jmpf.v10i2.54347.

Yamin, Y., Permanasari, A., Redjeki, S., & Sopandi, W. (2020). Implementing project-based learning to enhance creative thinking skills on water pollution topic. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(2), 225–232. https://doi.org/10.22219/jpbi.v6i2.12202.