Jurnal Pendidikan Teknologi Kejuruan, Vol. 6, No. 3, pp. 216-227, August 2023
e-ISSN 2621-1548; p-ISSN 2621-3273

Project-based learning module on creativity and entrepreneurship product subjects: Validity and empirical effect

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Received June 18th 2023; Revised July 28th 2023; Accepted August 24th 2023

Cite this https://doi.org/10.24036/jptk.v6i3.34323

Abstract: The learning process of Creativity and Entrepreneurship Product subjects in Vocational High Schools still uses printed books, resulting the students' boredom in learning the materials. Apart from that, the learning method used is the lecture method which is certainly less effective in supporting students' understanding on the materials so that learning is more teacher-centered. Meanwhile, the demand for the *Emancipated Curriculum* is that learning must be student-centered. This study aimed to develop learning tools for PjBL-based teaching module on the Creativity and Entrepreneurship Product subjects. This research was a research and development using the ADDIE development model. There were 12 experts who validated this module from 3 aspects, including material, media and model, and language aspects, and 30 students as participants for pilot study. The results of this research showed that this module is valid and has positive effects in supporting the learning process for the Creativity and Entrepreneurship Product subjects. This study brings pedagogical implications for the effectiveness of Creativity and Entrepreneurship Product subjects and is a method that can be implemented by teachers in the subject learning.

Keywords: Project-based learning; Creativity and entrepreneurship product; TVET, Vocational education; Quality education

1. Introduction

Vocational High School is a formal education unit that provides vocational education (Fuller, 2015). Vocational education is at the same level as high school which aims to prepare students to hone their skills, interests and talents to compete in the business and industrial world which currently shows a fierce competition (Kennedy, 2011; Waskito et al., 2022). Creativity and Entrepreneurship Product is one of the subjects taught at vocational schools and is included in the skills competency (C3) (Antonietti et al., 2022; Huda et al., 2021).

In Creativity and Entrepreneurship Product learning, student activities must include activities and learning materials that can increase the knowledge, skills and attitudes needed to create real work, create market opportunities and create real activities that have economic value from product output. Creativity and entrepreneurship and interactive learning include creating projects

(Olumide, 2015). In the Creativity and Entrepreneurship Product subjects, the learning process is currently still based on conventional learning activities in most vocational schools, so the learning objectives in current curriculum are still unable to achieve the learning achievement indicators that have been previously designed, as we know that conventional learning is a lecturing methods which in their approach pattern emphasize the skills/abilities of an educator in delivering learning. This pattern is still widely criticized by various educational groups because it is considered less effective in supporting students' critical thinking abilities, activeness and creativity (Novalinda et al., 2023). At this time, a new curriculum has been developed which requires students to be more active during the learning process so that learning is more teacher-centered (Monim, 2016; Prasetya et al., 2023).

Learning is a process of internalizing knowledge that occurs in the classroom involving teachers and students (Özoğul et al., 2020). The success of the learning process requires learning tools that support the learning process. Learning tools are currently undergoing updates, following the implementation of *Merdeka Curriculum* or also known as *Emancipated Curriculum*. In this curriculum, learning tools are called teaching modules. Teaching modules are learning tools which have been completely accumulated as a complement to previous learning tools and are the key in helping teachers organize the learning process (Hartanto et al., 2020; Jalinus, Syahril, et al., 2023; Schwendimann et al., 2018). The teaching module in its creation contains Learning Outcomes, Learning Objectives Flow, teaching materials, student worksheets, assessment rubrics, and evaluation. The teaching modules are completely arranged appropriately the learning process takes place more effectively and is able to achieve the learning objectives (Rozendaal et al., 2003).

Apart from learning tools, the use of learning methods that suit the characteristics of the teaching material is very important in supporting the learning process. The learning method that meets the characteristics of the Creativity and Entrepreneurship Product learning material is the Project-based Learning (PjBL) (Jalinus, Sukardi, et al., 2023; Syahril et al., 2019). The Project-based Learning is a learning method that provides students with the opportunity to process learning in the classroom where the students are the centered by involving project work so that they are able to find solutions to a real situation (Amamou & Cheniti-Belcadhi, 2018; Le et al., 2022), Project Based Learning is a learning model that carries out learning activities around student-centred project activities (Alves et al., 2011), projects are complex tasks based on problems that involve students in problem solving, decision making, designing, or investigation activities. This method will give students the opportunity to work in a structured, scheduled manner, and which in the end will provide an output that is based on the input that the students have received, where the output is a real and functional product (Syahril et al., 2020).

Learning tools based on Project Based Learning contain learning processes aligned with Project-based Learning syntax. They will make learning more structured because each learning activity is guided based on the stages contained in the learning tools. This will be the latest innovation that is able to provide an interesting learning experience for students and will have positive impacts on students' understanding of the material (Magleby & Furse, 2007). Thus, this research aims to develop Project Based Learning modules for the Creativity and Entrepreneurship Product subjects for vocational school students and determine the validity value of this module.

2. Methods

Design

This study is Research and Development (R&D) which is to develop a product as well as validate it. Research and Development is a research method used to produce and test certain products (Alias & Hasim, 2012).

Procedures

The development model used was ADDIE since it is an approach that emphasizes an analysis on how each component is related. It was also because the stages are systematic for instructional development. However, it was adjusted into 3 steps, including analysis, design and development.

a) *Analysis*. This stage was carried out to determine and observe as an effort to find solutions to problems at school. The analysis stages included: 1) analyzing the needs of students to find out what problems existed. 2) analyzing of learning outcomes to know what learning outcomes students have learned and mastered. 3) Analyzing the material/content according to the existing Learning Objectives Flow.
b) *Design*. This stage began with a framework development for making teaching modules based on PjBL. The reference in preparing teaching modules based on PjBL was product specifications/references that were created in different subjects but developed on a PjBL basis.
c) *Development*. In this stage, the questionnaire validity was tested to assess the feasibility of the module. After that, the limited trial was conducted to see the effectiveness of module to be applied broadly.

Participants

There were 30 students as participants in this study. Their involvement complied with the Declaration of Helsinki. Furthermore, 12 experts with expertise in material or content, media and model, and language to validate the module.

Instruments

Questionnaires were used as the instruments in this study for product validation and pilot study. Before carrying out validity tests and limited trials, a pilot study was carried out to see the validity and reliability of the questionnaires. The validity and reliability of these instruments can be seen in Table 1.

Table 1. Instrument Validity and Reliability Results

Instruments	Validity Score	Cronbach's Alpha Coefficient
Materials	0.86	0.95
Media and Model	0.88	089
Linguist	0.84	0.92
PjBL Module Efficiency	0.81	0.87
Learning Outcomes	0.91	0.83

Table 1 above shows the validity and reliability of instrument after conducting the pilot study. The results of data processing show that this research instrument is valid and reliable, so that the instrument can be used for data collection activities.

Data analysis techniques

There were 2 types of data analysis used in this study. In the validity test carried out by experts, the data analysis used was V coefficient, meanwhile a regression analysis was used for pilot study analysis. This regression analysis was used to find out whether there was a relationship between the two variables; PjBL module efficiency and Learning Outcomes.

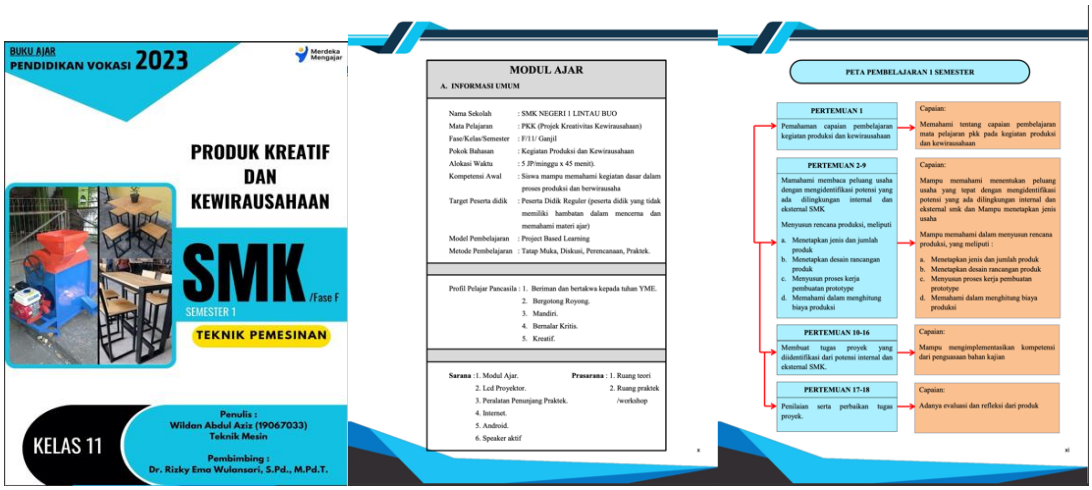
3. Results

This PjBL module was designed based on the needs analysis to overcome the difficulties experienced by students in learning Creativity and Entrepreneurship Product. The material in learning Creativity and Entrepreneurship Product must be accompanied by a project. Here, students not only study theory but also understand what field conditions are like when doing entrepreneurship. For this reason, it is necessary to design a PjBL Module that can ease students both to convey material in class and learn independently outside of the class.

An analysis of students' characteristics was carried out to assist researchers in developing Module. The results of this analysis are used as consideration for researchers in designing products. The participants of the module testing were Vocational High School students. Their ages range from 15 to 18 years, where they were entering the developmental stage of adolescence. These ages are their career exploration. They like to try new experiences in new situations. During adolescence, they are looking for identity, both related to intellectual, social-emotional, vocational and spiritual aspects.

According to Piaget's theory, the cognitive development of students aged over 15 years is at the formal operational growth stage. In this period, ideally students already have their own mindset in trying to solve complex and abstract problems, and can imagine many alternative problem solutions and their possible consequences or outcomes. At this stage, students no longer accept information as it is, but will process the information and adapt it to their own thinking. Generally, at this operational stage, students can think critically and logically. However, every student's critical thinking ability is not the same. The projects contained in the PjBL module can help students construct knowledge easier.

The PjBL module was designed in design stage with a prototype as the outcome. Test preparation, media selection, format selection, and initial design were carried out. The initial design of the PjBL module was completed before it was validated and piloted. At this stage, the framework for the PjBL module was prepared in the form of a PjBL module appearance design.



(a) (b)

Figure 1. (a) Cover and (b) Identity and Mind Map for 1 Semester of PjBL Module

Figure 1 shows the PJBL module cover, module identity, and learning map for semester 1 in Creativity and Entrepreneurship Products subjects. The teaching module for Creativity and Entrepreneurship Product subjects and machine engineering entrepreneurship by applying project-based learning methods is expected to improve the quality of learning and intelligence of students so that students can be more active and collaborative in theoretical and practical learning activities and can also help teachers in carrying out the learning process.

The module had undergone a validation process to obtain a validity category by 12 experts in the expertise including material, media and model, and language. The validity results are as shown in the following Table 2.

Table 2. Results of the validity value of the PjBL module

Expert	Score	Category
Materials	0.89	Valid
Media and Model	0.93	Valid
Language	0.91	Valid

Table 2 displays the results of validity scores of teaching modules that have been validated by validators. They are divided into 3 aspects and then processed by using V coefficient technique. An average validity score of 0.89 was obtained in material aspects which indicated the "valid" category. Media and models obtained an average validity score of 0.93 which is categorized as "valid", and the language aspect obtained an average validity score of 0.91 in the "valid" category.

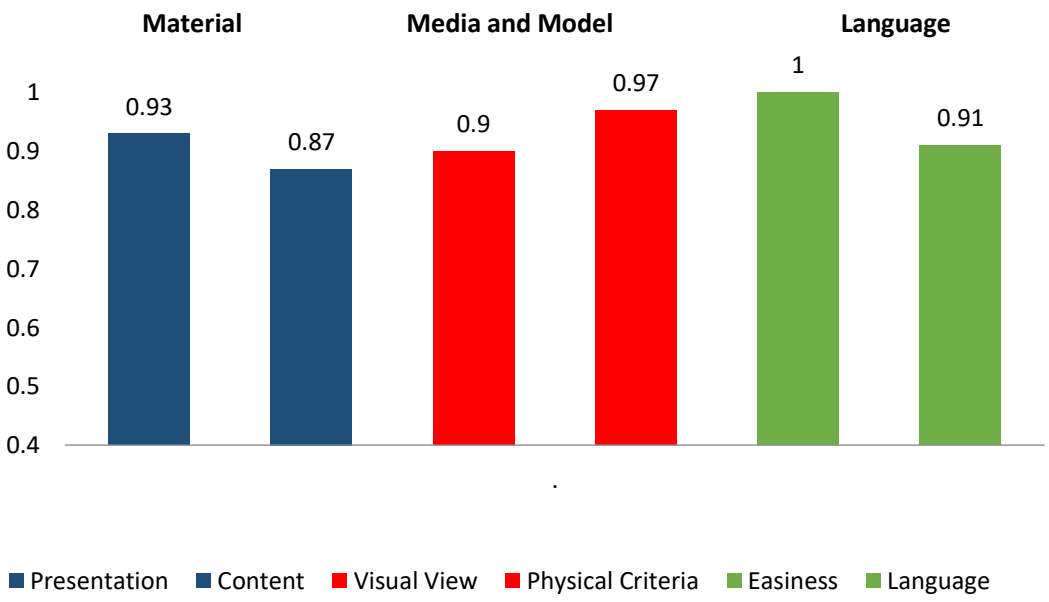


Figure 2. Per-aspect Validity Value

Figure 2 shows the score of three aspects. Material aspect which was divided into presentation was scored 0.93, as well as content which scored 0.87. The second aspect, media and model were divided into the visual appearance with a score of 0.90, and the physical criteria with a score of 0.97. Language aspects reached a score of 1 for easiness and 0.91 was scored for language. By referencing to the graph above, it can be concluded that the Creativity and Entrepreneurship Product teaching module based on Project Based Learning is suitable to be implemented in learning as proved by the validity scores of the 3 aspects which are in the " Valid" category as well as the validity scores of all aspects which indicated into "Valid" category. Therefore, this teaching module can be applied to vocational school students by implementing the Project Based Learning method.

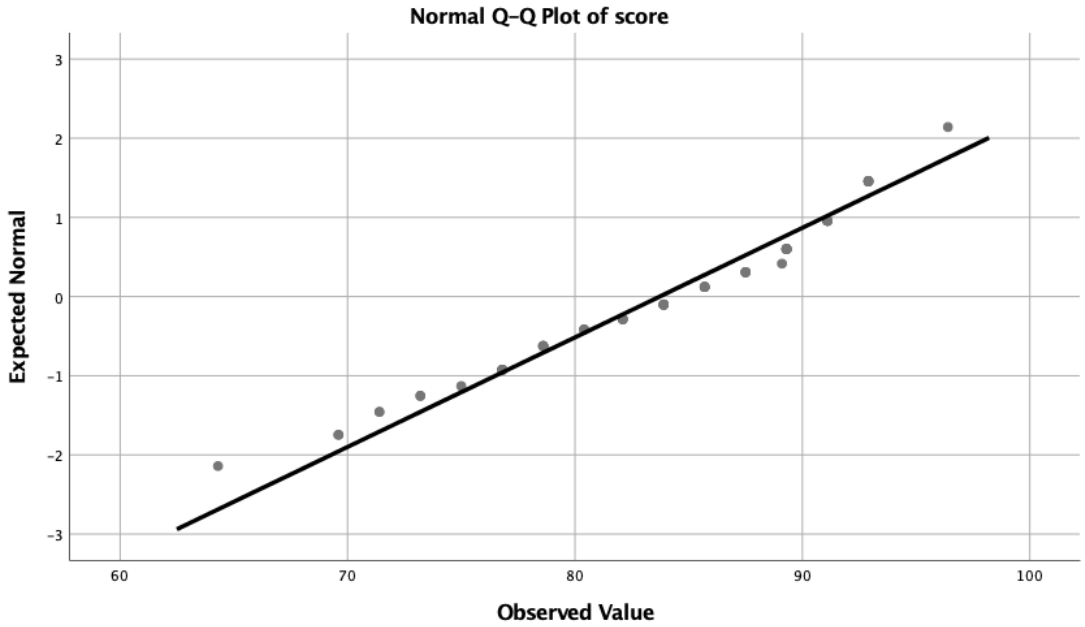


Figure 3. Normality Test's QQ Plots

Figure 3 shows the QQ plots of the normality test. The test results showed the data from PjBL Module Efficiency (P > 0.05, Z= 1.116) and Learning Outcomes (P > 0.05, Z= 1.101) indicate that the data for these two variables are normal. The linearity of these two variables can be seen in Table 3 below.

Table 3. Linearity Test of PjBL Module Efficiency and Learning Outcomes

Sig.	F	df
0.063	1.783	29

The result of the linearity test also shows that those two variables are linear (P > 0.05, F= 1.783). So that the two prerequisite tests for carrying out regression analysis have been fulfilled, normality and linearity. To be able to continue with the regression test, it is necessary to fulfill 1 more prerequisite test, which was the multicorlinearity test in Table 4 below.

Table 4. Multicollinearity Test

Variables	VIF	Sig	Tolerance	B	t
PjBL Module Efficiency (X1)	1.313	0.304	0.941	0.766	1.168
Learning Outcomes (X2)	1.382	0.240	0.878	0.240	1.506

Multicollinearity is a phenomenon in regression analysis where two or more independent variables in a regression model are highly correlated each other. In this context, the VIF value of all variables (X1=1.313; X2=1.382) was less than 10, it can be concluded that there was no multicollinearity disturbance in this variable, so it can be continued to carry out regression analysis.

Table 5. Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	58.946	6.450		25.120	.000
	Learning Outcomes	.855	.090	.830	10.864	.008

Table 5 shows the results of regression analysis to see the relationship between the efficiency of the PjBL module and learning outcomes. Based on this analysis, it was found that there was an influence of the PjBL module on learning outcomes (P < 0.05, t = 10.864) for 85.5%.

4. Discussion

This research was began with data collection before creating the PjBL module, followed by the analysis stage. The analysis stage was the initial stage of developing the PjBL module. This stage was carried out as a basis for developing the PjBL module in Creativity and Entrepreneurship Product subjects and it can be used to facilitate students learn independently. The results of the analysis were

used as guidelines and considerations in preparing the module. At the definition stage, several activities were carried out, including learning needs and student analysis.

In the learning needs analysis, a curriculum analysis was carried out where this analysis refered to the Independent Learning Curriculum based on the curriculum used in the learning process at Vocational High Schools. Then, in the student analysis, an analysis of the conditions and characteristics of the students was carried out. The participants of the pilot study were Vocational High School students aged 15 to 18 years, where the students were at the formal operational stage. In accordance with cognitive development according to Piaget, the cognitive development of children aged 15 years and over has reached the formal operational stage, which means it has advanced from the concrete operational stage. At this stage, ideally students already had their own mindset in trying to solve complex problems, and were able to imagine many alternative solutions to problems along with possible consequences or outcomes. This was in accordance with opinion (Knight & T., 2017) which stated that individuals/children at the formal operational stage were able to think critically.

After the analysis stage was complete, the product design stage was then carried out and continued with product development. This research produced a product in the form of a PjBL module on the subjects of Creativity and Entrepreneurship Product which was suitable as a learning medium. This was in accordance with opinion (Lamar et al., 2010) which stated that the module can facilitate students to learn independently. The PjBL model in the developed module can help students to enhance problem solving and critical thinking skills (Frank et al., 2003).

Stage by stage has been implemented according to development needs. Following the step, the development stage was carried out which were validation by media, language and material experts, and development trials in the form of pilot study. The purpose of validation by experts was to obtain input, criticism and suggestions for the module improvement. Validation of the developed PjBL module in this research emphasized three assessment aspects, specifically material aspects, language aspects and media aspects. Validation test data was obtained through a validation instrument filled in by 12 validators who were media/learning model experts, language experts and learning material experts.

This material expert validation was more focused on the correctness of the concepts presented in the PjBL module (Jun, 2010). Experts assessed the suitability of the material listed in the PjBL module with the learning objectives. From this assessment, input, criticism and suggestions for improvement were obtained. Therefore, the material presented did not deviate from the correct concepts and competencies that students must master. Validation by material experts was carried out once and then an evaluation was obtained by filling out a questionnaire by the expert regarding the correctness of the material and learning concepts. From the results of material validation by experts, it can be seen that the PjBL module that has been developed reached the valid category with an overall average score of 0.89. The results of this assessment were also in line with the results of previous research conducted by (Lamar et al., 2010), so that in terms of the correctness/accuracy of the material in the PjBL module, the PjBL module was suitable to be tested in the field.

Media and model expert validation was focused on the appearance and presentation of the model in the PjBL module. Validation by media and model experts aimed to ensure that the developed PjBL module product become a quality product. This validation was carried out twice. In the final stage of validation, an evaluation was obtained from filling out the questionnaire by experts. The questionnaire data were analyzed to determine the validity of the PjBL module in terms of media and model. From the results of data analysis, it can be seen that the PjBL module that has been

developed obtained the valid category with an average of 0.93. The results of this assessment were also in line with the results of previous research conducted by (S.Y. Chen et al., 2019), so that in terms of the quality of the display or presentation, this PjBL module was suitable to be tested in the field. Furthermore, the language aspect was 0.91 which was included in the valid category. So the teaching module that has been developed was said to be valid for use.

To see how much influence this PjBL module had on student learning outcomes, a limited trial was carried out on 30 students. The results of this limited test show that there was an influence of the PjBL module on learning outcomes ($P < 0.05$, $t = 10.864$). The influence of the PjBL module on learning outcomes was 85.5%. Study on the influence of Project-based Learning (PjBL) modules on student learning outcomes was important in the context of modern education. PjBL was a learning method in which students learn through real projects or assignments that include problem solving, collaboration, and application of knowledge in practical contexts (Gonzalez-Rubio et al., 2016). This was in line with research conducted by (Lei et al., 2012), where modules integrated with the PjBL model were effective in improving students' learning outcomes, problem solving abilities and critical thinking (P. Chen et al., 2015; Jalinus et al., 2020; Syahril et al., 2022). This was because the PjBL module allowed students to learn in a more in-depth and contextual way. Students learned through projects that required a strong understanding of concepts to achieve project goals. This can improve students' understanding of lesson concepts (Lehmann et al., 2008).

5. Conclusion

The study findings showed that PjBL-based teaching module products in Creativity and Entrepreneurship Product subjects have been developed and the development was carried out by the needs analysis stage, then product design, creating learning flows and learning materials. The overall validity of the teaching module according to material experts, media and model experts, and language experts was "valid" with a validity percentage of 0.89 respectively according to material experts, 0.93 according to media and model experts, and 0.91 according to language experts. The results of the limited trial also showed that the PjBL module had a positive effect on student learning outcomes by 85%. This research contributed to knowledge in adding references to the use of teaching modules in vocational education. This research will also have implications for curriculum development and decision making related to vocational education. This research only studied the effect of the PjBL module on learning outcomes and has not studied other variables. This could be a suggestion for future researchers who wanted to conduct similar studies.

Author contribution

Wildan Abdul Aziz played the role as a data collector, instructional module creator, data analyst, and article writer. Rizky Ema Wulansari acted as the provider of guidance and methods in module development. Randi Purnama Putra has made a significant contribution to the final article. Meanwhile, Hla Myo Tun, Chau Trung Tin, and Kyaw Zay Ya have provided direction in the compilation of the article.

Funding statement

The study did not receive specific grants from any funding agency in the public, commercial, or non-profit sectors.

Competing interest

The authors declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this study.

Acknowledgements

Thank you to all elements who have contributed to the development of Project Based Learning-based teaching module in the subjects of Creativity and Entrepreneurship Product. Thank you to the Mechanical Engineering Department of Universitas Negeri Padang, Vocational High School of 1 Lintau Buo, lecturers, teachers, and staff.

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