p-ISSN 2085-7411
e-ISSN 2623-0380

Exploring Bread Making: Developing an Interactive E-Module Based on a Project-Based Learning Model for Vocational High School Students

Seprika Sari[1]*, Abdul Hasan Saragih[2], R. Mursid[3]
[1,2,3]Department of Educational Technology, Universitas Negeri Medan, Sumatera Utara
*seprikasari@gmail.com

Abstract

This study aims to determine the feasibility of interactive e-modules based on project-based learning on bread material and the effectiveness of interactive e-modules based on project-based learning on bread material. This research method uses research and development (R&D) through the Borg & Gall research and development model and the Dick & Carey learning model. The study was conducted in class XI Culinary Arts, SMK Telkom 2 Medan. The results of the study showed that: (1) interactive e-modules based on PjBL on bread material developed based on validation from material experts were 98.33% or very feasible; (2) based on learning media experts were 93.84% or very feasible; (3) based on learning design experts were 90% or very feasible; (4) based on student field trials were 88.96% or very feasible; and (5) interactive e-modules based on PjBL on bread material developed based on N-Gain results on the difference in pre-test and post-test scores with a result of 0.38 were in the range of 0.2 <d <0.8 with a moderate level of effectiveness.

Keywords: Bread, Culinary, E-Module, Interactive, Project-Based Learning.

Received: March 5, 2024. Revised: May 25, 2024 Accepted: June 26, 2024

Article Identity:
Sari, S., Saragih, A.H., & Mursid, R. (2024). Exploring Bread Making: Developing an Interactive E-Module Based on a Project-Based Learning Model for Vocational High School Students. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, 16(1), 9-25.

INTRODUCTION

The rapid development of communication and information technology increases the demand for competent workers in this field. The development of the digital industry provides very promising career opportunities for Indonesia's current and future young generation, so the demand for workers who have skills and abilities that suit the needs of the digital industry is increasing.

The increasingly rapid development of technology has encouraged the replacement of print technology with computer technology in learning activities. Modules, which were originally printed learning media, were transformed into electronic form, giving birth to a new term, namely electronic modules, or what is known as e-modules. Electronic modules, or e-modules, are defined as learning media using computers that display text, images, graphics, audio, animation, and video in the learning process (Nugraha, Subarkah, & Sari, 2015). Smeets and Bus (2014), revealed that electronic books that are embedded with multimedia features can enrich the book reading experience if used correctly. Interactive electronic books are the best alternative that can contribute to increasing reading comprehension and interest.

It is hoped that the increasing demand for a generation that is digitally literate will allow vocational high school students to have greater opportunities because they have been equipped with practical and theoretical aspects at school. However, this still needs to be supported by appropriate learning methods and industry standard materials so that the provisions provided by schools or teachers to students are maximized. Currently, schools use a curriculum based on the Ministry of Education and Culture of the Republic of Indonesia, which still uses basic material and is included in the old material category, so it is not relevant to current developments in industrial technology.

Based on the achievement of student learning outcomes in productive learning of bakery and pastry products in class The results of student creativity in the field of bread ingredients have not shown satisfactory grades. Based on the results of interviews conducted with students regarding the learning process, it was stated that students were less enthusiastic about following the bread material, and teachers were less innovative in delivering the material (reviews and presentations), and there were no project-based interactive E-modules that showed student creativity. Currently, teachers only create text modules that are only given to teachers during teaching.

Telkom 2 Medan Vocational School is a Center of Excellence Vocational School with many supporting facilities. Every year, academic achievements are achieved at the school. In addition, among 614 public and private vocational schools in Indonesia, this school is ranked 28th in excellence. Because e-modules are included in the reference school program, The development of PjBL-based electronic modules (e-modules) as learning resources used in the learning process on bread material is highly anticipated. So that students can understand the material, they need to use efficient and effective learning resources through e-modules. E-Module emphasizes process skills and active learning, so media is very important in the teaching and learning process in the digital era. By completing the module with instructions and directions that can increase students' independence, mastery of skills will help students become competent and capable and learn according to their abilities.

E-modules can arouse students' enthusiasm based on their skills, the content is relevant to phenomena, communicative, easy to learn, and allows students to produce critical opinions. The benefits of using electronic modules as learning resources in the academic field include enabling students to develop their scientific assets outside of the classroom; encouraging students to think critically and behave in open-ended ways; and improving their ability to be sustainable.

One of the teaching materials that can facilitate learning for students is e-module teaching material. A video, image, animation, and others provide feedback for students. This is an advantage of e-modules over printed modules because e-modules have an interactive nature (Mahayukti & Suarsana, 2013).

E-Module

E-modules are an equalizer of technological progress, which has now left many printed materials to be published in digital format. The difference between modules and e-modules is how to read them (Ummah et al., 2020).

E-modules are multimedia and non-printed digital learning with a systematic layout with various features developed in accordance with module layout

guidelines. This e-module is structured with an independent learning approach and problem-solving methods for the learning objectives to be achieved. E-modules are also developed by adapting to the curriculum and learning units according to the level and method of development. E-modules are technological advances that convert printed modules into electronic modules. People can use or create the characteristics of printed modules, but e-modules have digital features, so the production is the same as printed modules. (Erick Suryadi et al., 2019).

Wulansari et al. (2018) introduced e-modules as a form of digital teaching material where the learning material is in the learning menu contained in it, which can be used independently by students personally and can be accessed at any time. Teachers can be facilitators in learning where students individually or independently carry out tasks or assignments in the e-module so that students can, through teacher guidance, solve problems (Setiawan et al., 2016). Students can improve their learning outcomes independently with electronic modules. The e-module developed can be the right alternative for an interesting learning model with pictures and videos while not causing boredom in learning. Imansari & Sunaryantiningsih (2017) stated that e-modules can also display text, images, animations, and videos in packages that are good for the learning process via computers or other digital devices. This is in accordance with the following statement: student learning outcomes using interactive books are better than printed books (Suyatna, Maulina, Rakhmawati, & Khasanah, 2018).

Kurniawan (2015) states that interactive modules use a variety of media, which include various elements and components such as sound or audio, text, images, moving cartoons or animations, videos, and diagrams or graphics stored in other recording devices or published via internet pages, so that interaction occurs between media and users (two-way or reciprocal). According to Prastowo (2015), an interactive electronic module is a module that combines two or more interactive texts, graphics, audio, video, or animation to control the interaction between media and users. Therefore, electronic or digital modules can be connected with animation, video, and audio and enable interaction.

Project-Based Learning (PjBL)

Mahendra (2017) explains that the project-based learning model is a student-centered learning approach that allows students to develop strategies, work together on projects, and create products that can be seen by others. Tritanto (2014) states that this model is an innovative educational approach that is student-centered. This model allows teachers to help students and gives students the opportunity to create their own lessons. Project-based learning is a learning approach that allows students to collect and integrate new information through activities that occur in the real world.

Project-based learning is intended to be applied to complex problems that require students to research and understand them. Listiani and Purwanto (2018) state that in learning with the project model, the query process begins with a guiding question. Then, teachers help students carry out projects in cooperation and collaboration that can integrate various subjects into the curriculum. Students can quickly discover the important components and principles of the field they are studying by answering these questions.

The project-based learning model involves thorough research on a relevant topic that captures students' attention and effort. In the project-based learning model (PjBL), projects are an important part of the learning process. PjBL's focus is to help students understand concepts and principles through in-depth problem solving, self-study, and creating their own products.

Tabel 1. PjBL Model Syntax

PjBL Syntax	Syntax Description
Design Purpose	There are three steps: (1) problems and needs, describing the reasons for determining the project and product, posing the problem, and finding a solution; (2) target customers and constraints, describing targets and considering constraints; and 3) design objectives, establishing expected requirements.
Field of Inquiry	Thoroughly identifying and analyzing the learning project Source information is included in the second stage, including the identification of technical, scientific, and social aspects, as well as the organization and evaluation of the information.
Solution Alternatives	The potential of various ideas or ideas that have never been done or tried before and provide suggestions and instructions regarding documentation ideas; consider all factors; consequences and consequences; and other people's perspectives.
Choosing the PreferredSolution	When selecting one of the alternative solutions made at the stage of proposing an alternative solution, the concepts noted are taken into consideration.
Operation Steps	Planning to implement the selected solution includes checklists, supplies of materials, components, materials, tools and prototyping.
Evaluation	After the activity is completed, it is done to consider the next activity.

Source: Doppelt, Y. (2005). Journal of Technology Education.

Bread Material

Bread is a food product made from wheat flour that is fermented with baker's yeast or other leavening agents and processed by baking (Mudjajanto and Yulianti, 2004). Bread is included in one of the conventional biotechnology products because of the fermentation process that utilizes microorganisms (Mudjajanto and Yulianti, 2007).

Bread is made through two processes, namely baking and baking, both of which are very important in determining the quality of the final bread product. There are various types of bread, namely steamed bread, toasted bread, and fried bread. White bread and sweet bread are types of baked bread (Suprapti, 2003).

The nutrients contained in bread are β-carotene, thiamine (vitamin B1), riboflavin (vitamin B2), and niacin, as well as a number of minerals in the form of iron, iodine, calcium, and so on. Bread is also enriched with certain amino acids to improve the quality of protein in the body. The protein content in bread reaches 9.7%, higher than rice, which is only 7.8% (Jenie, 1993).

Almost all types of bread are made using the same process, namely mixing, fermentation, proofing, sheeting, molding, baking, cooling, and (sometimes) slicing) (Zhou and Hui, 2004).

Bread is a food made from wheat flour and water, fermented with yeast, but some do not use yeast. However, with advances in technology, humans have prepared bread with various ingredients such as salt, oil, butter, or eggs to add protein levels to it to obtain a certain texture and taste. Bread is a staple food in many Western and Middle Eastern countries. Bread is the base of pizza and the outer layer of sandwiches. Bread is usually sold sliced and freshly packaged neatly in plastic. Bread is a food made by fermenting wheat flour with baker's yeast (Saccharomyces cerevisiae) or digestive bacteria. Butter can be mixed with savory ingredients such as salt, sugar, milk or milk powder, fat, chocolate, sauce, and chuckade.

Bread is a processed food product that is the result of the process of baking fermented dough. The main ingredients in making bread consist of wheat flour, water, yeast, and salt. Meanwhile, ingredients to enhance flavor and increase nutritional value and color are granulated sugar, milk, and eggs, as well as softening ingredients, namely fat. To strengthen gluten, extend shelf life, and increase vitamins, yeast, or what is often called an improving agent, is a bread improver (Faridah et al., 2008).

The bread that is better known to the public is plain bread, often referred to as white bread or sweet bread. Sweet bread is called that because the bread tastes sweet and savory with a variety of filling ingredients, such as fruit, chocolate sprinkles, cheese, fruit jam, meat, and vegetables. This bread has very varied and interesting flavors and shapes. The aim of making bread is to fulfill food needs and function as a breakfast, snack, and snack. The raw materials for bread consist of wheat flour, yeast, sugar, eggs, salt (NaCl), water, milk, and butter (Auliana, 2011).

Interactive e-module based on project-based learning (PjBL)

Learning media used on computers are called electronic modules or e-modules and consist of text, images, diagrams or graphics, sound or recordings or audio, animation or cartoon movements, and videos used in learning (Nugraha, Subarkah, & Sari, 2015). Project-based interactive e-modules are a combination of interactive e-modules and steps taught by projects so that students can gain relevant knowledge. An interactive e-module is defined as a module that interactively combines two or more directions of text, graphics, audio, images, and video to control certain commands and provides two-way connectivity between modules.

According to constructivist learning theory, students should be given the opportunity to assess and understand the situations they experience themselves because this will make their learning more meaningful (Hussain, 2012). This creative learning model gives students the opportunity to debate with each other and participate in solving problems based on what has been discussed. (Buck Institute for Education in Ibnu, 2014). Therefore, project-based interactive e-modules are digital learning resources that have text, images, video, and audio. Navigation consisting of links makes it more interactive and helps complete project tasks.

The formulation of the problem in this research is: (1) Is the PjBL-based interactive e-module suitable for use in the learning process on bread material;

and (2) Are PjBL-based interactive e-modules effective in improving student learning outcomes in bread material?.

RESEARCH METHOD

This research is a type of development research, commonly called research and development (R&D) development. Development research is research that aims to produce a product through a development process. According to Borg and Gall (2003), the stages of educational research and development are actually included in the Dick & Carey (1996) model.

The purpose of development research is not only to develop products, but more than that, to discover new knowledge or to answer specific questions regarding practical problems (through applied research).

This research was conducted at Telkom 2 Medan Vocational School on Jalan Harat No.68 Medan, North Sumatra. The research was conducted in class.

This model includes ten stages of development. The development model consists of: (1) collecting research information; (2) plans for design; (3) developing initial product formats; (4) preliminary field trials; (5) revisions or improvements to the primary test product; (6) main field test; (7) revision or improvement of operational products; (8) on-site operational testing; (9) product revision operations; and (10) socialization and implementation. Meanwhile, the instructional design uses the Dick & Carey model, the steps of which can be seen in Figure 1 below.

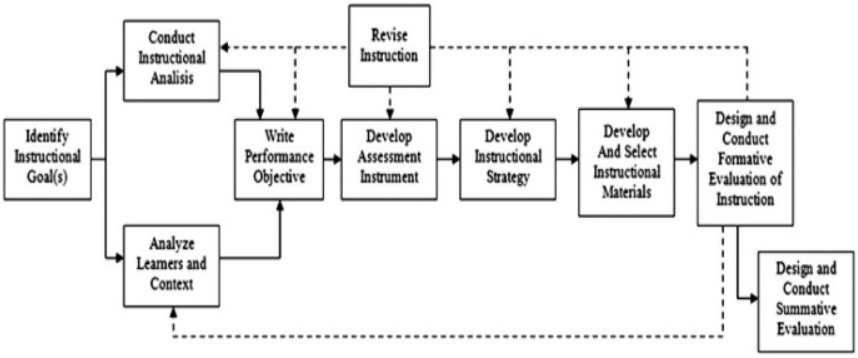

Figure 1. Dick and Carey Instructional Design Model

Media Validity Data Analysis. Media validity analysis includes data analysis of validation results from material experts, media experts, and learning design experts. Data collection was carried out using a questionnaire in the form of a Likert scale by distributing questionnaires to respondents, namely material expert validators, media expert validators, and learning design expert validators.

Next, the test is used as a data collection technique. The tests that will be given are a pretest at the beginning before learning begins and a posttest at the end after the learning process uses PjBL-based learning e-modules. Data analysis techniques were obtained through student pretests and posttests. As a result, the data was then analyzed using N-gain to obtain student pretest levels and posttest results. Increase in N-gain.

$$g = \frac{\text{S post} - \text{S pre}}{100 - \text{S pre}}$$

Description:
g (gain) = Increase in student learning outcomes
S pre = Average pretest (initial test)
S post = Posttest average (final test)
The gain score classification can be seen as follows:

Table 2. Gain Score Improvement Categories

Interval	Category
(g) ≥ 0,7	High
0,3 ≥ (g) < 0,7	Moderate
(g) < 3	Low

RESULTS AND DISCUSSION

Results

The results of validation and product trials on Class XI students at SMK Telkom 2 Medan will use an interactive module for bread ingredients based on the PjBL model in this research and development. Teacher test results, student reactions, verification of teaching materials by experts, and verification by media experts determine the quality of learning media.

Before the trial was carried out, the PjBL-based interactive e-module was validated by material experts. Material experts carry out this validation, which is carried out by lecturers in the field of food from Medan State University who have knowledge of the materials used. The purpose of this validation is to collect information, criticism, and suggestions needed to ensure that the PjBL-based interactive e-module developed by the developer is a quality product in all aspects. The validation results are shown in Table 3 below:

Table 3. Material Expert Validation Results

No	Item Rating	Average
A	Aspect of Self-Instruction	
	1. Synchronous learning objectives relate to existing core and basic abilities.	5
	2. The material is arranged according to core skills and basic abilities.	5
	3. The material is presented with the flow of its preparation.	4,5
	4. The material can be understood easily by students.	5
	5. Illustrations are presented in accordance with the material offered by module.	5
	6. Learning can be linked to the student's task and environment	5
	7. Use of language that students can understand.	5
B	Self-Contained Aspect	
	8. Compatibility of module material with core skills and basic abilities.	5
	9. Material competencies include core skills and basic abilities.	5
C	Stand Alone Aspect	
	10. Can study the material from this module on your own.	4,5
D	Adaptive Aspect	

	11. The material is in accordance with advances in science and technology	5
E	User Friendly Aspect	
	12. One can study module material anywhere and at any time	5
	Total Number	59
	Total Mean	4,92

The material expert validation results had a total score of 59, with a percentage of 98.4%, and an average score of 4.92 for the "Very Eligible" category.

Validation results from media experts to obtain information, criticism, and recommendations to ensure that the PjBL-based interactive e-module created has quality design, layout, visual communication, and graphics. Below is Table 4.

Table 4. Media Expert Validation Results

No	Item Rating	Average
A	Design	
	1. Fast and easy media access (there are helpful tools)	4,5
	2. Layout that is useful and easy to see	5
	3. Choice of contrasting colors	4,5
	4. Provision of materials for learning purposes	4,5
	5. Module titles, subtitles, and supporting text appear more professional when compared to the font size of the web page.	4,5
B	Layout	
	6. Conformity of parts to expected layout	4,5
	7. Correspondence between the large number and small number of letters used in teaching materials	5
	8. Selection of appropriate images for teaching material pages and order	4
C	Graphics	
	9. Appropriateness between video content and images or visuals used in the context of digital learning materials	4,5
	10. The images or visual content selected in the video are clear and easy to understand for age-appropriate students.	5
D	Visual Communication	
	11. Teaching materials are delivered well.	5
	12. Display learning videos for interesting digital learning materials	5
	13. Compatible with images, videos and writing, and can explain the material being taught	4
	Total Number	60
	Total Mean	4,62

Validation from media experts shows that the sum of the questionnaire scores reaches 60 with a percentage of 92,4% and an average score of 4.62 for the "Very Decent" category.

The results of validating the learning design are to obtain information, criticism, and suggestions so that the PjBL-based interactive e-module that is made into a product is better than the results in terms of design, layout, visual communication, and graphics. In Table 5.

Table 5. Validation Results of Learning Design Experts

No	Item Rating	Average
A	Design	
	1. Fast and easy media access (there are helpful tools)	5
	2. Layout that is useful and easy to see	4,5
	3. Choice of contrasting colors	4
	4. Provision of materials for learning purposes	5
	5. Module titles, subtitles, and supporting text appear more professional when compared to the font size of the web page.	3,5
B	Layout	
	6. Conformity of parts to expected layout	4,5
	7. Correspondence between the large number and small number of letters used in teaching materials	4
	8. Selection of appropriate images for teaching material pages and order	5
C	Graphics	
	9. Appropriateness between video content and images or visuals used in the context of digital learning materials	5
	10. The images or visual content selected in the video are clear and easy to understand for age-appropriate students.	4
	11. Visual Communication	
	12. Teaching materials are delivered well.	5
	13. Display learning videos for interesting digital learning materials	5
	14. Compatible with images, videos and writing, and can explain the material being taught	4
	Total Number	58,5
	Total Mean	4,5

The results of learning design experts on PjBL-based interactive e-modules show that the total score of the questionnaire reached 58.5 with a percentage of 90%, with an average score of 4.5 or 90% for the "Very Appropriate" category.

Results of individual, small group, and field or main trials on PjBL-based interactive e-modules carried out by Class XI SMK students at Telkom 2 Medan Vocational School, on all aspects of: (1) learning display; (2) presentation of learning; and (3) the benefits of learning using PjBL-based interactive e-modules on bread material From the test results data on students, it shows an assessment of 89% with an average score of 4.43 for the "Very Eligible" category.

The results of the PjBL-based interactive e-module assessment on bread material at Shandy Putra 2 Vocational School, Medan, on teacher responses are shown in Table 6:

Table 6. Results of Teacher Responses to Products

No.	Item Rating	Average
1	The appearance of the e-module is very interesting	4,5
2	E-modules present material in a structured manner so that it is easy to understand.	4
3	Students may be interested in studying the topics presented in the e-module.	4
4	Users can interact easily with e-modules.	4,5
5	Using the examples provided in the e-module can help you understand the material.	5

No.	Item Rating	Average
6	The bread material e-module has very complete material and the learning features are very useful for students.	3,5
7	During the process of learning bread material, we faced difficulties when using e-modules.	4
8	It was very helpful for us how the e-module explained the learning activities.	5
9	It is very fun to use the bread material e-module during Teaching and Learning Activities	4,5
10	We are more motivated by the e-module because the material that will be discussed by the teacher can be studied earlier.	4
11	We prefer to study with teaching modules because e-module material is boring and unstructured	4,5
13	We are more interested in learning with e-modules	5
14	We can determine our level of learning ability by using e-modules.	3,5
15	We can study independently or in groups through e-modules	4
16	We obtained new information from the e-module material.	4,5
17	Attractive and innovative e-modules	4,5
18	The use of e-modules to assist the learning process is not effective	4
19	In e-modules, there are stages of learning activities that make us more active in learning.	5
20	Through each learning activity in the e-module, we can conclude and develop new ideas and creativity regarding bread.	4,5
	Total Number	82,5
	Total Mean	4,34

Teacher responses to the development of interactive e-module products based on PjBL on Bread Material averaged 4.34 or 86,8% with the predicate "Very Eligible."

The results of the PjBL-based interactive e-module assessment on bread material at Shandy Putra 2 Vocational School, Medan, on student responses are shown in Table 7:

Table 7. Results of Student Responses to Products

No.	Item Rating	Average
1	Description of learning material that is simple to understand.	4,39
2	E-modules have clear and easy to follow material.	4,43
3	Through the images included in the e-module, students can gain a better understanding of the material.	4,65
4	Projects and assignments have clear objectives and are relevant to the lesson	4,57
5	Each learning stage in the e-module is explained.	4,57
6	Flowcharts explain the technique very clearly.	4,91
7	Because of the e-module learning stage, students are more active.	4,87
8	Students can share information with their group mates during the project thanks to the e-module feature.	4,52
9	By using e-modules, group discussions become more active.	4,48
10	The database learning process becomes easier with e-modules.	4,39
11	In e-modules, videos help understand the project work process.	4,65
13	The project instructions in the e-module are easy to understand.	4,74

No.	Item Rating	Average
14	We face challenges to complete the tasks given in the e-module.	4,61
15	Facilities are very useful for talking and sharing experiences.	4,78
16	By using e-modules, we feel more motivated to study in groups.	4,65
17	The operation of the e-module is very simple.	4,83
18	By using e-modules, studying bread material becomes more fun.	4,65
19	Students can learn faster and understand lesson material more easily by using e-modules during the learning process.	4,65
20	E-module learning gives us new experiences.	4,57
	Total Mean	4,63

The students' response to the development of interactive e-module products based on PjBL on Bread Material averaged 4.63 or 92.6% with the predicate "Very Eligible".

Testing of the value of normalized gain (N-Gain) was carried out on the pretest and posttest results of class IX students in the Culinary Study Program at SMK Telkom 2 Medan to find out whether student learning with the media used had improved after being given treatment. Student scores before and after the test determine improvement, as shown in Table 8.

Table 8. Student Learning Results with PjBL-based Interactive e-Modules

No.	Student Initials	Pretest	Posttets
1	ABS	80	95
2	AZ	82	85
3	ARS	85	95
4	CMWG	85	85
5	ERP	86	90
6	GMS	73	92
7	GA	83	89
8	HNB	76	88
9	IAW	80	85
10	JK	80	86
11	KSL	87	90
12	KHRS	85	87
13	KSDP	82	96
14	MS	77	90
15	MRC	87	87
16	MR	77	82
17	NSA	80	90
18	NKP	87	90
19	NSC	80	90
20	RFS	87	87
21	RA	82	90
22	RAP	79	87
23	SFM	87	90
	Average	82,04	88,96

To calculate the normalized gain score (N-Gain), use the following formula: Table 8 above shows the calculation of learning outcomes, which shows that the

actual gain score is the gain score received by the student, and the maximum gain score is the highest gain score the student may receive.

$$< g > = \frac{<88,96> - <82,04>}{100 - <82,04>} = \frac{6,92}{17,96} = 0,38$$

The following table shows the effect sizes according to Cohen from normalized assessments:

Table 9. Effect Size Criteria

Effect Size	Criterion
$0 < d \leq 0,2$	Small effect
$0,2 < d \leq 0,8$	Moderate effect
$d > 0,8$	Large effect

Source: Naga, 2005

The pretest and posttest gain results are normalized using various interactive e-modules. For example, the pretest results with the Android-based interactive e-module were normalized with a result of 0.38 in the range $0.2 < d \leq 0.8$ with the "Medium Effect.".

Discussion

Development of a PjBL-based interactive e-module on bread subjects to help students understand the concepts and steps of bread-making techniques and simplify the learning process for students both at home and at school. From the results of the analysis of learning resources and based on observations, it is known that students have difficulty understanding the material because they do not have handbooks, especially bread subject books. The development of e-modules is very necessary and should be implemented because it can increase student learning resources. PjBL-based e-modules are arranged in a structured manner according to the PjBL-based learning model. Thus, the development of e-modules in the bread subject is very necessary, especially for Class XI students at Telkom 2 Vocational School, Medan.

Based on validation tests from learning material experts regarding bread, learning design experts based on PjBL, and validation from learning multimedia experts, all showed an average assessment of 91.4% in the "very decent" category. Likewise for PjBL-based interactive e-module trials for individual trials, small group trials, and field trials in the "Very Feasible" category. So that the PjBL-based interactive e-module product developed is suitable for use in the learning process for class XI students at SMK Telkom 2 Medan.

The same research conducted by Dwi, Salam, and Warneri (2023) in their research on the development of PjBL-based e-modules for creating interactive multimedia shows that PJBL-based e-module media is suitable for use as material for creating interactive multimedia. The results of responses from students, which were measured by percentages, obtained an average response of student interest of 96.34%, and student motivation in learning reached an average of 93.26%. The effectiveness test was carried out through a pretest and posttest involving 30 participants with a significance of less than 0.05, indicating that there was a significant difference between the pretest and posttest. Based on this, it is

concluded that PJBL-based e-module learning media is effective in improving learning to create interactive multimedia on multimedia skills competencies.

This PJBL model is one of the four main learning models whose practice is adapted according to the 2013 curriculum. Apart from being able to foster students' interest in learning (Sulisworo, 2020), learning with the PJBL model is also dynamic on world issues (Boss & Krauss, 2022) and encourages creativity on a deeper scale in creating multimedia designs that adapt to market demands (Rozanda & Maisaroh, 2012) in universal PJBL study. Ramadhan (2021), learning methods have an impact on student learning success. Meanwhile, the choice of E-module media was made because e-modules are very suitable for learning activities in vocational schools in order to train creativity and independence in learning (Herawati & Muhtadi, 2018). In this case, the Ministry of Education and Culture also issued practical guidelines for those preparing learning e-modules and procedures for preparing e-modules so that researchers have a clear reference in the development process carried out on PjBL-based interactive e-modules.

PjBL-based interactive e-module media can be used in project-based learning. The project-based learning model will encourage students to produce a project in their learning so that it will hone students' skills in creating interactive multimedia (Winatha, 2018). This result is also supported by the results of other research, which states that project-based learning has a positive influence on the motivation and learning of vocational school students (Chiang & Lee, 2016). The effectiveness of the PJBL e-module has also been proven effective in learning electric motor installation for vocational school students (Laili et al., 2019).

E-modules can be combined with innovative learning models, which are seen as capable of improving learning outcomes. The learning model used in this research is project-based learning. Project-based learning in the development of PjBL-based interactive e-modules is an approach to creating a learning environment that can encourage students to construct knowledge and skills personally. In recent years, many studies have revealed that project-based learning is very effective if it is actually applied in learning, including: (a) increasing student motivation in learning (Liu, 2016); (b) facilitating a better process of understanding concepts (Wekesa & Ongunya, 2016); (c) increasing engagement in students' learning and academic performance (Iwamoto, Hargis, & Vuong, 2016); (d) increasing problem-solving abilities in various situations (Movahedzadeh et al., 2012); and (e) improving students' social skills (Styla & Michalopoulou, 2016).

Project-based learning in the implementation of PjBL-based interactive e-module learning is considered suitable for digital simulation subjects. Digital simulation is part of a group of productive subjects in the independent curriculum that are required in all class XI vocational school skills programs. This subject equips students with skills for utilizing productive learning on bread material, which is currently very much needed in the culinary world. The skills in question include managing food in the form of cakes and bread into various processed snacks and can be applied in society in general as well as in the upper-class culinary world. Apart from that, this bread subject aims to equip students to be able to develop and practice directly making various breads that they have discovered themselves or modify existing ideas or concepts through processing bread foods.

Mastery of concepts related to learning material really determines the quality of students ability to apply their knowledge in the world of work. Therefore, the development of PjBL-based interactive e-modules in the form of projects is considered important to increase motivation, conceptual understanding, problem-solving abilities, and social skills. The same research conducted by Winatha, Suharsono, and Agustini (2018) stated that the development of this learning medium was based on the unavailability of innovative teaching materials that were in accordance with the demands of the 2013 Curriculum in digital simulation subjects at Bali Global Singaraja IT Vocational School. In order to produce the expected product, the development procedure used is the ADDIE model, which consists of five stages, namely: analysis, design, development, implementation, and evaluation. The research results show that the results of the interactive e-module design that has been developed for digital simulation subjects using an innovative project-based learning model have been successfully implemented and are feasible to implement in the learning process.

CONCLUSION

Research and development of interactive e-modules based on PjBL in the subject of making bread for grade XI students of SMK 2 Telkom Medan can be concluded as follows: (1) Interactive e-modules based on PjBL in the subject of pastry and bakery bread material based on validation from learning material experts, media experts, and design experts, as well as from individual student trials, small group trials, and teacher responses, show results that are "very eligible." This means that interactive e-modules based on PjBL in the subject of pastry and bakery bread material can be used in the learning process for the subject of making bread; and (2) Interactive e-modules based on PjBL in the subject of pastry and bakery bread material based on the results of practical learning in making bread for the pretest and posttest classes show a significant increase, so that "effective" results can improve learning outcomes after using interactive e-modules based on PjBL in the subject of bakery bread material.

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