Module Development of Project-Based Learning to Increase Student Independence and Study Results in Disruption Era

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INTRODUCTION

Simulation and Digital Communication (Simdig) is one of the subjects at level (C1) in Vocational High Schools (SMK) that needs to be taught in all areas of expertise. The era of the Covid-19 pandemic demands that various sectors of activity can be carried out digitally as much as possible, including in the implementation of education (Haryati *et al*, 2021). The implementation of education during the WFH period needs to implement online learning reinforcement. Therefore, online learning is very much needed in learning (Dhawan, 2020).

Learning at SMKN 6 Malang, especially the Computer Engineering and Informatics expertise program, uses a project-based learning model. Project-based learning is a learning that involves a project in the learning process (Rusman, 2017) which involves students in learning science and skills through the process of investigating real

problems (Purnawan *et al*, 2016) so that it can stimulate learning activities and improve students' understanding of the material presented by the teacher (Hidayat *et al*, 2019).

Project-based learning, in addition to requiring the delivery of material, also requires structured exercises that can guide students to carry out assignments in the form of making projects (Kokotsaki *et al*, 2016). In this case, the problem lies in schools that do not yet have modules that are structured using the project-based learning model. Limited learning resources affect students' learning independence to be low (Sumbawati *et al*, 2020). Low learning independence can also affect low student learning outcomes. Learning outcomes are obtained from activities after the learning process, namely in the form of assessments from cognitive, affective, and psychomotor aspects (Eriyanto *et al*, 2021).

Independence is the behavior of individuals who are able to take the initiative, are able to overcome obstacles/problems, have self-confidence without the help of others (Sipayung dan Siswono, 2022), reconstructive and actively determine goals in learning, then plan something deeper in the learning that is passed, and students are also willing to be active in the learning process (Permana, 2011). Optimizing student learning independence requires learning media that are directed and can be used effectively and without limits (Puspitarini and Hanif, 2019).

LITERATURE REVIEW

A module is a small unit of teaching and learning program that is studied by students individually (self-instructional) (Ali and Elsayed, 2022) so that students can learn independently either with or without teacher guidance (Prastowo, 2011) and can directly practice or solve the problems given (Ahmad, 2017). Students can complete their learning individually (Novalinda *et* al, 2022), and the module can be used by students as a clear guideline in learning (Logan *et al*, 2021). So that the module can improve student learning independence and learning outcomes (Pramana and Dewi, 2014).
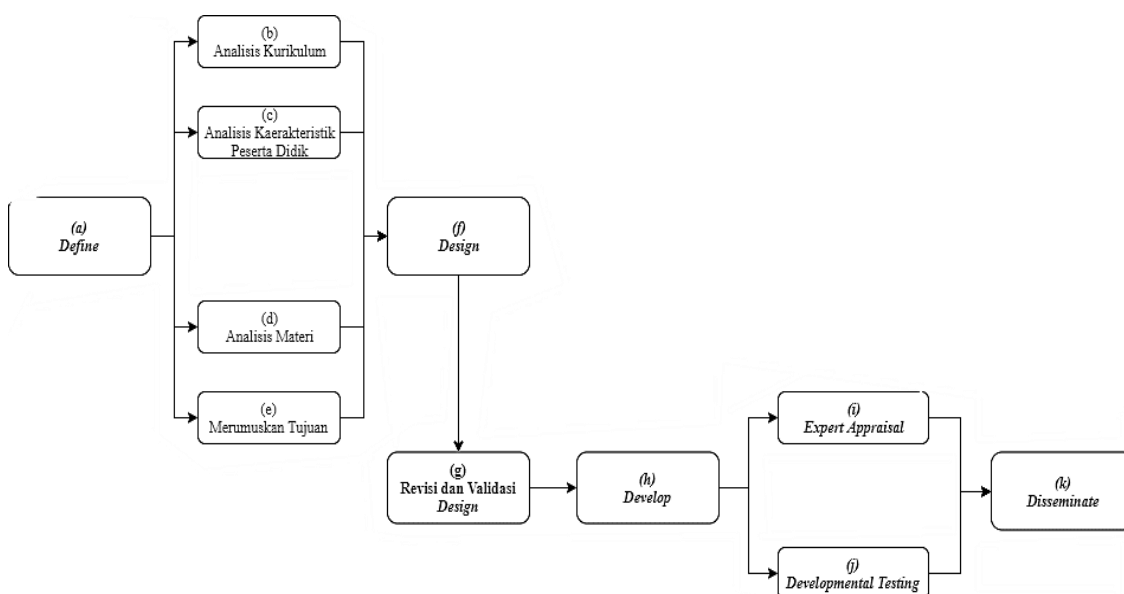
RESEARCH METHOD

Figure 1. Research Procedure and 4D Development
Source: Mulyatiningsih (2016)

Method used in this research are by research and development (R&D) adapting 4D research method:

a. Define

Through this stage, the explanation of the problems related to the implementation of learning in the subjects of simulation and visual communication is known and the background to the development carried out.

b. Design

The design stage in this study is to produce a product in the form of a printed module for students in the Simulation and Digital Communication subjects that contain a project-based learning model in the form of a prototype. The prototype produced has the potential to become a real module product, so in the design process the results of the needs obtained at the definition stage are adjusted.

The developed module has special characteristics so that it can guide students to be able to learn independently and has been equipped with tests that are useful for measuring student learning success, which is assumed to be in formative tests and summative tests.

Supporting the creation of learning activities whose output is that students create a work in the form of a product so that the presentation of learning is represented in the syntax that can be seen in **Table 1**.

Table 1. Module Activity Design with Project-Based Learning

No.	Activities	Notes
1	Determining Basic Questions	Represented in basic questions to find out students' knowledge and experience.
2	Providing knowledge related to basic concepts and basic principles of learning	Delivery of information that must be known and mastered by students that is adjusted to the learning achievement objectives in the module.
3	Providing exercises and structured steps	Realized in the form of structured exercises and practical steps so that they are easy for students to follow.
4	Providing problems	Raising problems from simple to complex to hone students' thinking skills.
5	Providing projects	Giving assignments in the form of projects.
6	Delivering student work results and evaluating learning experiences	Delivery of student work results and self-reflection on the learning process that has been carried out.

c. Develop

The product that has been designed in the form of a prototype is then carried out in the development stage. At this stage there are two steps that must be taken, including:

1) Expert Appraisal

Is a technique to validate or assess the feasibility of a product design rationally carried out by experts. Assessment by experts requires an instrument in this study, a non-test instrument using a questionnaire containing a rating scale, namely a questionnaire containing questions followed by columns indicating levels (Arikunto, 2013). The questionnaire is used to collect quantitative data using Likert Scale scoring with criteria that can be seen in **Table 2**.

Table 2. Likert Scale Score Criteria

Score	Information
4	Strongly agree/very good/very appropriate/very suitable
3	Agree/Good/appropriate/suitable
2	Quite agree/Quite good/quite appropriate/quite suitable
1	Disagree/not good/not appropriate/not suitable

Source : Arikunto (2013)

The equation used to process validation data from material experts and media experts is:

$$Va = \frac{\sum \frac{Se}{}}{\sum \frac{}{Sh}} \times 100\% \quad \text{........ (1)}$$

Explanation:

Va : Validasi Ahli or Experts validation

$\sum$ Se : Sum of Skor Empiris (overall respondent answer results)

$\sum$ Sh : Sum of Skor Harapan (total maximum score)

The guidelines for making decisions in measuring the level of validity of the module developed based on Arikunto's (2013) validity criteria can be seen in **Table 3.**

Table 3. Module Eligibility Criteria

No	Validity Criteria	Validity Level
1	80,01%-100,00%	Very valid and can be used without revision
2	65,01%-80,00%	Valid and can be used with minor revisions
3	55,01%-65,00%	Quite valid and can be used after partial revisions
4	01,00%-55,00%	Less valid and cannot be used

Source: Arikunto (2013)

2) Developmental testing

Conducting product design trials on real target objects. The trial stages in the research and development of this learning module are carried out in stages consisting of 2 stages, namely: alpha testing to test the validity of the evaluation test items (Alimah, 2012), and beta testing to test the feasibility of the module as a teaching material for real users (Yuwono and Suprapto, 2011). Testing the feasibility of the module is realized in the form of individual trials, small group trials, and large group trials or usage trials. Individual trials can be conducted on 1-3 students, according to Arikunto (2013:254) small group trials can be conducted on 4-14 students, and large group trials can be conducted on 15-50 students.

d. Disseminate

In this final stage, the module has been developed, validated, and tested to distribute. In this case, due to limited space during the pandemic, the distribution is carried out by sending e-book files through subject teachers so that they can be disseminated to students either in the learning process or not.

RESULT AND DISCUSSION

1. Product Development Results

This research yields a product in the form of a module on the subject of Simulation and Digital Communication Containing Project-Based Learning for 10th grade students, which is compiled in accordance with the competency standards of the 2013 Curriculum for 1 even semester consisting of 7 basic competencies, namely KD 3.8 and 4.8 to KD 3.14 and 4.14.
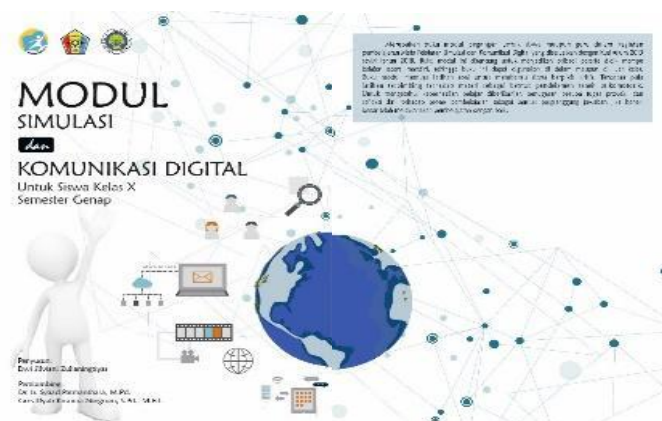
Figure 2. **Cover Display**

The module has a concept map presented in the form of a hierarchy or position of chapters or sub-chapters between one another in the preparation of a teaching module. The module is presented in two main chapters. First, the Communication and Network Collaboration Chapter, which has four sub-chapters of discussion: 1) Digital Citizenship; 2) Search Engines; 3) Communication in Networks; and 4) Virtual Classes. Second, the Concept Visualization Chapter which contains three sub-chapters of discussion: 1) Basic Videography; 2) Video Production and Making Animations; and 3) Post Production.
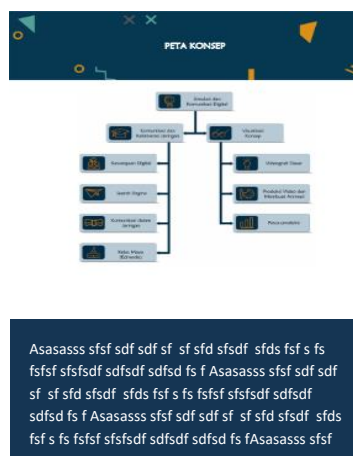
Figure 3. Concept Map

Modules that contain complete material, appropriate with the latest technological developments, and easy to obtain, are able to make students learn effectively and independently (Mawarni and Muhtadi, 2017). The modules developed in this study contain a project-based learning model, so that the provision of individual and group

projects is the core activity of project-based learning (Majid & Chaerul in Mutmainah, 2016).

2. Data Presentation and Module Validation Analysis
a. Media Expert Validation

The media expert validation process was carried out by Mrs. Gres Dyah Kusuma Ningrum, S.Pd., M.Pd as a lecturer in Informatics Engineering Education, Department of Electrical Engineering, Faculty of Engineering, State University of Malang who is an expert in developing media and teaching materials, one of which is developing printed books. The results of the media expert validation that have been obtained are shown in **Table 4.**

Table 4. Media Expert Validation Results

| No	Aspect	TSe	TSh	Validity (%)	Notes
1	Components and Feasibility of Module Presentation	59	64	92,18	Very Valid
2	Principles of Visual Design	61	68	89,70	Very Valid
TOTAL		120	132		
AVERAGE				90,94	Very Valid

The results of the module validation from media experts obtained a percentage of the component aspects and the feasibility of the module presentation of 92.18% and a percentage of the visual design principle aspect of 89.70%, so that an average validation value of 90.94% was obtained. Referring to the decision-making guidelines for measuring the level of module validity developed by Arikunto (2013) shows that the Simulation and Digital Communication subject module containing Project-Based Learning that was developed is declared Very Valid/Very Feasible so that the module can be used without revision.

b. Material Expert Validation

The material expert validation process was carried out by Mrs. Juni Triastuti, S.Kom as a productive teacher in charge of Simulation and Digital Communication subjects at SMKN 6 Malang in the field of Computer Engineering and Informatics. The results of the material expert validation that have been obtained are shown in **Table 5**.

Table 5. Results of Material Expert Validity

No	Aspect	TSe	TSh	Validity (%)	Notes
1	Eligibility of Module Content	57	64	89,06	Very Valid
2	Principles of Visual Design	50	60	83,33	Very Valid
TOTAL		107	124		
AVERAGE				86,29	Very Valid

The results of the module validation from the material experts obtained a percentage of the component aspects and the feasibility of the module presentation of 89.06% and a percentage of the visual design principle aspect of 83.66%, so that an average validation value of 86.29% was obtained for the Simulation and Digital Communication subject module containing Project-Based Learning. Referring to the decision-making guidelines for measuring the level of module validity developed by Arikunto (2013), it shows that the Simulation and Digital Communication subject module containing project-based

learning that was developed was declared Very Good/Very Feasible so that the module can be used without revision.

3. Data Presentation and Analysis of Test Items Validity Test

The validity test of test items is used to determine the level of eligibility of the questions. So, before the questions are tested, the level of validity must be known in order to have great support for the question score, in other words, if a question has a high level of validity, it is one that is parallel to the total score (Arikunto, 2013: 90). The validity of the question items is known through the significance level set, namely 0.05, in which case the question is said to be valid if r count > r table, conversely the question is said to be invalid if r count < r table.

$$\gamma\rho bi = \frac{Mp - Mi}{St}\sqrt{\frac{p}{q}}$$

The validity test of the 15 test questions obtained 10 test questions that were declared valid, namely numbers 1, 2, 3, 5, 7, 10, 11, 13, 14, 15 and 5 questions were declared invalid, namely numbers 4, 6, 8, 9, 12. So that invalid questions must be discarded and valid questions can be used for research. In addition to the validity test, a reliability test was also carried out as seen in **Table 6.**

Table 6. Test Items Reliability Test Results

Cronbach's Alpha	N of Items
,679	10

The results of the test item reliability trial are in accordance with the results of the question validity referring to the criteria for determining the test item reliability by (Arikunto, 2013) which is classified as high reliability. So that valid questions can be used as test instruments to obtain student learning outcome scores in the development of simulation and digital communication modules containing project-based learning.

4. Presentation of Trial Result Data
a. Individual Trial Result Data

Individual trials involved three students from class X RPL 2 SMKN 6 Malang. The results of the individual trials obtained a percentage of 80.95%. In the aspect of module presentation, it was 85.00%, the aspect of module content was obtained at 75.00%, the aspect of language use was 77.77%, and the aspect of graphics was 81.25%. The results of the individual trials that have been obtained are shown in **Table 7**.

Table 7. Individual Trial Result Data

No	Aspects of Assessment	Score				SUM	Max	Percentage
		(1)	(2)	(3)	(4)	($\sum$)	Score	(%)
1	Module Presentation	0	2	5	8	51	60	85,00
2	Module Content	0	1	4	1	18	24	75,00
3	Language Usage	0	2	4	3	28	36	77,77
4	Graphics	0	1	7	4	39	48	81,25
TOTAL						137	168	
PERCENTAGE						$p = \frac{137}{168}$ x 100% = 80,95%		

Looking at the data above, it can be analyzed that the learning module is very feasible or can be used in learning without revision. Students argue that the module is able to support independent learning process learning because it contains complete content and has clear directions about learning objectives. This is supported by research by Dewi, A.F (2019) which states that learning modules are used so that students can understand clear directions during the learning process.

b. Small Group Trial Result Data

The small group trial involved 7 students from class X RPL 2 SMKN 6 Malang. The results of the small group trial obtained a percentage of 82.14%. The details of the presentation of quantitative data obtained in each aspect include the module presentation aspect of 81.42%, the module content aspect of 80.35%, the language use aspect of 84.52%, and the graphic aspect of 81.25%. The detailed results of the small group trial are presented in **Table 8**.

Table 8. Small Group Trial Result Data

No	Aspects of Assessment	Score				SUM	Max	Percentage
		(1)	(2)	(3)	(4)	($\sum$)	Score	(%)
1	Module Presentation	0	3	19	13	115	140	81,42
2	Module Content	0	2	7	5	45	56	80,35
3	Language Usage	0	2	9	10	71	84	84,52
4	Graphics	0	2	17	9	91	112	81,25
TOTAL						322	392	
PERCENTAGE						$p = \frac{322}{392}$ x 100% = 82,14%		

Looking at the data above, it can be analyzed that the learning module is very feasible to be used in learning without revision. The delivery of material using simple and straightforward language stimulates learning motivation. Moreover, with the presence of illustrations that make it easier to digest the information conveyed. Pribadi (2017:76) stated that the description of the material in the book and the support of appropriate visual illustrations, the contents of the information and knowledge contained therein will be easily understood by the reader.

c. Large Group Trial Result Data

The large group trial involved 23 students from class X RPL 2 at SMKN 6 Malang. The results of the large group trial reached a percentage of 85.09%. The percentages obtained in each aspect include the module presentation aspect of 84.77%, the module content aspect of 86.36%, the language use aspect of 85.98%, and the graphic aspect of 85.51%. The results of the large group trial that have been obtained are shown in **Table 9**.

Table 9. Large Group Trial Result Data

No	Aspects of Assessment	Score				SUM	Max	Percentage
		(1)	(2)	(3)	(4)	($\sum$)	Score	(%)
1	Module Presentation	0	3	65	47	389	460	84,77
2	Module Content	0	2	25	20	157	184	86,36
3	Language Usage	0	3	33	33	237	276	85,98
4	Graphics	0	2	53	38	313	368	85,51
TOTAL						1096	1288	
PERCENTAGE						$p = \frac{1096}{1288}$ x 100% = 85,09%		

Looking at the data obtained above, it shows that the developed learning module is declared Very Good/Eligible so that the module can be used without revision. The implementation of project tasks in teams is also able to train cooperation between friends, such as the opinion of Magta (2019), and also Zhang and Ma (2023), in his research which states that project-based teaching methods can influence children's cooperation skills.

5. Presentation of Learning Outcome Data
a. Individual Learning Outcome Data

The learning outcomes in the individual trial can be obtained from the individual student learning outcomes, the percentage before learning using the module was 71.66%, while after learning using the module was 80.00%. The individual trial learning outcome data can be seen in **Table 10**.

Table 10. Individual Trial Learning Outcome Data

No	Student Name	Score	
		Before	**After**
1	AZAHRA	74	80
2	HESTINA	69	80
3	OKI NOVIA	72	80
TOTAL		215	248
Average		71,66	80.00

Improved learning outcomes are triggered by personal curiosity and initiative to explore the information they want to know. Apart from that, learning outcomes can also be presented with the presentation of relevant learning resources that can support students' learning needs. Supported by research by Sa'adah (2018), and also Webb and Doman (2020) which states that the use of textbooks as a source of student learning has an impact on increasing knowledge, attitudes and skills that are better and more honed.

b. Small Group Learning Outcome Data

The learning outcomes in the small group trial can be obtained from individual student learning outcomes, the percentage before learning using the module was 70.00%, while after learning using the module was 81.42%. Individual learning outcome data can be seen in **Table 11**.

Table 11. Small Group Trial Learning Results

No	Student Name	Score	
		Before	**After**
1	DITA GADIS	79	90
2	ESA M	74	80
3	ILVI H	74	80
4	INSANIA	60	90
5	MERIDA D	74	80
6	M BANGGA	69	80
7	NABILA	60	70
TOTAL		542	490
AVERAGE		70,00	81.42

The average value obtained by students after using the module was 81.42. Looking at the learning outcome data in the small group trial, the results of the learning outcome analysis by Yesintha (2017) were categorized as being in the Effective category. After receiving lessons using the module and filling out the evaluation instrument, all students obtained learning completion scores according to SKM ≥ 70 and on average experienced

an increase in achievement scores. Through the increase in learning outcomes, it can be seen that the use of modules is able to strengthen and expand students' knowledge (Nilasari, et al., 2016).

    c.   Large Group Trial Learning Outcome Data

In the implementation of this trial usage, respondents directly tried the learning activities in KB 3 which discussed digital puppeteer animation. Student learning outcomes are shown in **Table 12**.

Table 12. Large Group Trial Learning Outcome Data

No	Student Name	Score	
		Before	**Afeter**
1	AHMAD ARIA	57	80
2	CHELVIN	71	90
3	DENY A	60	90
4	DICKY	63	80
5	DIVA ADAM	76	80
6	ELANG SURYA	64	90
7	ELZA FIRDA	69	80
8	EMIL F	74	70
9	ENDANG F	69	80
10	FARHAN J	58	80
11	FERNANDO	69	80
12	FINA A	72	70
13	FRIAN FERRY	73	80
14	HAIDEE C	64	60
15	HAQ RAGIL	74	80
16	INDI SEILIA	72	80
17	INDRA ADI	63	80
18	KHAIRUNNISA	69	90
19	LINTANG	70	80
20	MIA SAFIRA	64	80
21	M NADZIF	59	70
22	M SYAHRUL N	74	80
23	REFA EMA	69	80
TOTAL		1544	1553
Average		67,52	79.56

The average score obtained by students is 79.56. When observed as a whole, it can be shown that there is an increase in the learning outcome score between before the learning treatment using the module and after, which is 12.04%, which refers to the category of learning outcome analysis results by Yesintha (2017), is included in the category Quite Effective.

In this trial, students showed that they were able to follow each step presented correctly and were able to quickly master the tools provided in the application. Some of them have even started to develop themselves by exploring creative and innovative ideas. As a study by Zakiah (2020), which states that knowing the level of understanding of the work that has been created can help to plan creative ideas to produce innovative work.

Basically, the implementation of the project-based learning model will make students more actively involved (Rachmawati et al., 2017) in the teaching and learning process and be able to make learning take place collaboratively (Kristanti et al., 2016), with the prominence of cooperation between students (Sari et al., 2015). In addition, the use of this model in learning shows an influence on student learning outcomes that have increased from before (Rati et al., 2017). Learning activities containing project-based learning can be carried out systematically in the module so that students can master the

learning objectives that are implemented (Hasanah, et al., 2018). The results of this study are in line with Yulianti's research (2014) that the learning module containing project-based learning is very feasible and relevant to be used in learning.

6. Data Presentation and Analysis of Learning Independence

Learning independence is seen from the level of responsibility for collecting assignments by students and is also obtained through response statements in the user assessment questionnaire form, the analysis of learning independence can be seen in **Table 13**.

Table 13. Data on Learning Independence Results

No	Statement Aspects	Score				SUM ($\sum$)	Max Score	Percentage (%)
		(1)	(2)	(3)	(4)			
Part 1 Not Dependent								
	I am able to understand the material written in the module	0	0	24	9	108	132	81,81
Part 2 Confidence								
	I am able to do the practice tasks given through the module with confidence.	0	4	23	6	101	132	76,51
Part 3 Disciplined								
	I am able to complete the practice assignment on time	0	5	17	11	105	132	79,54
Part 4 Responsible								
	I can understand the terms contained in the module	0	2	23	8	105	132	79,54
Part 5 Initiative								
	I remain diligent in studying even though I encounter obstacles when doing assignments/exercises.	0	2	18	13	110	132	83,33
Part 6 Self Control								
	I am able to obey the teacher's orders while studying	0	0	15	18	117	132	88,63
TOTAL						646	792	
PERCENTAGE						$p = \frac{646}{792}$ x 100% = 81,56%		

Looking at the results of independent learning when conducting individual trials, small group trials, and large group trials, the results show that the concept of learning in individual and small group work groups is still more effective because the number of students per class can still be monitored, so that each student can carry out tasks based on their abilities fully and be responsible for themselves. However, during the implementation of the large group trial, there were students who were not able to do the tasks independently and responsibly yet, in other words, they were still collaborating with their friends. So that independent learning in large groups is said to be negative. The results of the study are supported by the opinion of Sadikin and Hamidah (2020), who stated that online learning has flexibility in its implementation and is able to encourage the emergence of independent learning but also has the weakness that online learning is not well supervised in large class learning.

The availability of learning resources can facilitate independent learning (Bella, 2017), because teaching materials are a necessity that greatly supports the achievement of student competencies (Wildan, 2017). Therefore, the development of modules containing project-based learning can be a mainstay for students to become independent in carrying out the learning process.

CONCLUSION

The results of the research and development (R&D) of the module that has been carried out are produce a simulation module and digital communication containing project-based learning that has been tested for feasibility by media experts, material experts, and users, namely students, with very feasible results and without any revisions to be used as teaching materials.

The implementation of this research and development, in addition to determining the level of module feasibility, also determines the effectiveness of the module on student learning outcomes and learning independence. In its implementation, learning using modules can improve student learning outcomes in the realm of knowledge or cognitive, as seen from the acquisition of evaluation test data of 7-12%, the percentage of increased learning outcomes from students who previously studied without using modules with learning outcomes after using the module.

The level of learning independence is actually fostered from within each individual, based on the results of the module trial in individual and small group classes, learning independence is still high because each student is able to be responsible for completing tasks well and in accordance with instructions and on time. However, in large groups, learning independence is not fully fulfilled because each individual student still has collaboration between friends. Apart from that, the assessment of learning independence using the module based on the results of respondents obtained an average value of 81.56%, which in this case the effectiveness of the module on learning independence was stated as Very High so that the module was able to meet students' needs in independent learning activities.

As for suggestions related to the use of modules, namely the use of modules should always be carried out by following all the activities in them sequentially and completely in order to achieve maximum learning outcomes for both students and teachers as facilitators who always direct and guide students in order to facilitate the implementation of learning activities in the module.

Other than that, suggestions regarding further development that can be done are that it is necessary to conduct research on the application of modules that are truly effective for use in learning, especially online. And add additional facilities that are more useful.

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