# Development of Project-Based MERIE (Motivation, Engagement, Reinforcement, Implementation, Evaluation) Learning Model with Cisco Packet Tracer Application in Administrative Subjects Class XI E Network Infrastructure SMK Negeri 1 Siatas Barita Regency North Tapanuli

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**Abstract.** This study aims to determine 1) Development of a project-based MERIE learning model using the Cisco Packet Tracer Application for Network Infrastructure Administration learning in class XI E of SMK Negeri 1 Siatas Barita 2) The feasibility level of the projectbased MERIE learning model (Motivation, Engagement, Reinforcement, Implementation , Evaluation) of students, material experts, media experts and learning practitioners Network Infrastructure Administration SMK 3) The level of effectiveness of learning outcomes in the Network Infrastructure Administration subject using the Cisco Packet Tracer application. The research method used in this study adapted the ADDIE development model, namely a development model consisting of five stages which include Analysis, Design, Development, Implementation and Evaluation. The results showed that the "MERIE" learning model and the Cisco Packet Tracer Application in the Network Infrastructure Administration subject proved feasible to use because they had gone through validation tests from material experts, instructional designs, media, learning practitioners, individual trials, small group trials and tests. field, and the result is declared “Very Good”. The learning outcomes of students in using the Cisco Packet Tracer application in the learning process of Network Infrastructure Administration using the "MERIE" Learning Model show that there is a significant difference compared to the learning outcomes of the Discovery Learning learning model where from the different test results obtained t count (5.51) > t table (2.048). From the results of the effectiveness test, the "MERIE" learning model and Cisco Packet Tracer applications have a higher level of effectiveness than the Discovery Learning learning model.

**Keywords:** Project-based MERIE Learning Model, Cisco Packet Tracer Application, Level of feasibility of the MERIE learning model (Motivation, Engagement, Reinforcement, Implementation, Evaluation).

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# 1 Introduction

Project-based learning according to Fathurrohman  is a learning model that uses projects or activities as learning tools to achieve attitude, knowledge and skill competencies. This learning is a substitute for learning that is still centered on the teacher (teacher center). The emphasis of this learning lies on the activities of students who at the end of learning can produce products that can be meaningful and useful[1]

Students will be more motivated because it turns out that working hard to complete a project is a fun activity. Various sources that describe project-based learning media will make students more active and successful in solving complex problems. In completing the project it is necessary to develop communication skills in group work. If implemented properly, students will learn and practice in organizing projects, making time allocations and other resources such as equipment to complete projects [2].

Vocational secondary education is an educational level that prioritizes the preparation of students in carrying out certain types of work in the world of work and also develops their professional attitude. Vocational high schools (SMK) are classified into several groups, including Business and Management Vocational Schools, Automotive Engineering Vocational Schools, Information and Communication Engineering Vocational Schools, Culinary Vocational Schools, Tourism Vocational Schools, Arts Vocational Schools, and others. One of the competency skills at the Vocational High School (SMK) education level is Computer and Network Engineering (TKJ). Computer and network engineering is a competency area that further specializes students in computer learning such as assembling computers, installing hardware and software, creating computer networks and so on. One of the subjects accepted by students majoring in TKJ is Network Infrastructure Administration which is a productive subject belonging to the content of vocational specialization which is devoted to the competence of TKJ expertise, namely C3 contained in the K13 curriculum. This subject is a difficult subject, because students are expected to be able to describe a simulation of a computer network using a Cisco Packet Tracer application.

Application of Cisco Packet Tracer as one of the core competencies of productive Computer and Network Engineering in vocational high schools is teaching material that is given to students in the second year of learning at school. This Cisco Packet Tracer application material does require precision and accuracy from students during practice.

Preliminary observations made by researchers at SMK Negeri 1 Siatas Barita, regarding student learning outcomes in the Network Infrastructure Administration (AIJ) subject only discussed theory derived from school handbooks, without direct practice regarding network simulation with the Cisco Packet Tracer application. This results in the value of the skills acquired by students at the end of learning every odd and even semester. The skill value given by the teacher is only based on the knowledge value possessed by students. What's more, during online learning during the Covid 19 pandemic from 2020-2021, teachers are only limited to providing material knowledge to students through online learning using gadget devices and not carrying out practical activities from VLAN configuration learning materials. The value of the knowledge and skills of students during 2020-2021 can be seen in Table 1.1 below.

**Table 1.1** Value of Knowledge and Skills for Network Infrastructure Administration Subject at SMK Negeri 1 Siatas Barita

Enrollment in local colleges, 2005

| No | School Year | Knowledge Value | Skill Value |
|---|---|---|---|
| 1 | 2020/2021 | 80 | 80 |
| 2 | 2021/2022 | 85 | 85 |

Source: Network Infrastructure Administration Subject Teacher at SMK Negeri 1 Siatas Barita, September 2022

From Table 1.1 above, it can be seen that the value of knowledge and skills in the network infrastructure administration subject in the 2020/2021 school year is still lower than the value of knowledge and skills in 2021/2022. This condition is most likely caused by the consequences of online learning during the pandemic, where learning is totally carried out from students' homes. So that the network simulation practice material is not conveyed to students. Whereas in the 2021/2022 school year, students only practice network simulations with the Cisco Packet Tracer application in the even semester, where the practical material provided to students is only limited to building a simple network.

Based on the background above, there are several problems in this study. The problems can be identified as follows:

1. Students have difficulty understanding the Network Infrastructure Administration subject.

2. Teachers still use conventional methods in learning Network Infrastructure Administration at SMK Negeri 1 Siatas Barita.

3. Teachers do not involve active students directly in the learning process of Network System Administration by using the Cisco Packet Tracer application.

4. The development of the Project Based Learning learning model as an alternative to the Network Infrastructure Administration learning model in class XI E of SMK Negeri 1 Siatas Barita is still lacking.

5. The Cisco Packet Tracer application is still not used in the implementation of learning by teachers to students.

Based on the problem identification above, the purpose of this research is to find out:

1. Development of a Project Based Learning (PjBL) learning model using the Cisco Packet Tracer Application for learning Network Infrastructure Administration in class XI E of SMK Negeri 1 Siatas Barita

2. The level of feasibility of the MERIE learning model (Motivation, Engagement, Reinforcement, Implementation, Evaluation) for students, material experts, media experts and learning practitioners of SMK Network Infrastructure Administration.

3. The level of effectiveness of learning outcomes in Network Infrastructure Administration subjects using the Cisco Packet Tracer application.

Development of the "MERIE" Learning Model:

1.M(otivation)/ Motivation

motivation to learn is an internal and external encouragement to students who are learning to make changes in behavior, generally with several indicators or elements that support.

The teacher is not only tasked with playing a role in organizing learning, but is also responsible for arousing learning motivation for students. The motivation given by the teacher to students also provides a push or pull towards changes in behavior and goals to be achieved.

2. Student E(ngagement)/active student

The word engagement according to Wikipedia means promise or agreement. When combined with the word student engagement, it will have the meaning of being the willingness and effort of students to be involved effectively in every school activity that contributes to successful outcomes (Trowler, 2010). Trowler also classifies student engagement into behavioral, cognitive, and emotional involvement.

3. R(einforcement)/Strengthening

In Indonesian, the word Reinforcement means reinforcement, to increase behavior that is expected to be repeated. Behaviors followed by reinforcement actions will be repeated in the future. In conclusion, reinforcement is a consequence that can strengthen behavior [4]

4. I(mplementation)/Implementation

An activity or action of a plan made in detail to achieve a goal is called Implementation. According to [5] in his book entitled Curriculum-Based Implementation Context: "Implementation is based on activities, actions, actions, or the mechanism of a system. Implementation is not just an activity, but an activity that is planned and to achieve the objectives of the activity. The definition of implementation described above is that implementation is not just an activity, but also a planned activity carried out based on seriously planned references.

5. E(valuation)/Evaluation

The word "evaluation" comes from English, namely evaluation from the root word value which means value or price. In general, evaluation can be interpreted as a systematic process of determining the value of something (provisions, activities, decisions, performance, processes, people, objects and others) based on certain criteria through assessment [6]. In another sense, evaluation, measurement and assessment are hierarchical activities. These three activities are related to the learning process which cannot be separated from each other and in their implementation and must be carried out sequentially.

## 2 Method

This research was conducted at SMK Negeri 1 Siatas Barita Jalan Marhusa Panggabean No. 41 Simorangkir, Siatas Barita District, North Tapanuli Regency, North Sumatra Province. The research entitled "Development of a Project Based Learning (PjBL) Learning Model with the Cisco Packet Tracer application in the subject of Class XI E Network Infrastructure Administration at SMK Negeri 1 Siatas Barita, North Tapanuli Regency" is a research and

development (Research and Development). This research procedure adapts the ADDIE development model, which is a development model consisting of five stages which include analysis, design, development, implementation and evaluation. Researchers modify the development model according to needs.

The procedure for developing a Project Based Learning (PjBL) Learning Model with the Cisco Packet Tracer Application at SMK Negeri 1 Siatas Barita, consists of five stages, namely:

1. Stage of Analysis (Analysis)

In the analysis phase, field observations were carried out at SMK Negeri 1 Siatas Barita. Researchers analyzed the curriculum used by SMK Negeri 1 Siatas Barita. Researchers analyzed competencies which included an analysis of Core Competencies (KI) and Basic Competencies (KD) which were published in this media.

2. Design Stage (Design)

Based on the needs analysis, the next stage in the development procedure is the design stage. The design stage includes making covers, module layouts, material preparation and network design. **Table 3.1** shows some of the subject matter that will be practiced.

**Table 3.1** Practice Matery

| No | Main Subject |
|---|---|
| 1 | **VLAN Network Configuration** |
| 2 | **Configure IP Address** |

3. Development Stage

Furthermore, at the development stage is the stage where the design that has been made becomes a reality in the form of a finished product.

4. Implementation Stage

The implementation stage is the product trial stage that has been made by the researcher.

5. Evaluation Stage (Evaluation)

Each stage of the ADDIE process involves an evaluation. It is multidimensional and an important component of the ADDIE process. After obtaining data from the application of the Cisco Packet Tracer Application with the help of learning modules, then the data is analyzed to determine its effect on learning outcomes by carrying out normality tests, homogeneity tests and hypothesis testing.

In this development research the research subjects were class XI E students of SMK Negeri 1 Siatas Barita, material experts, media experts and learning practitioners of Computer and Network Engineering SMK and the object of research was the development of a Project Based Learning learning model with the Cisco Packet Tracer Application.

The type of data used is mixed methods research, which is a method or procedure used to analyze and combine quantitative and qualitative research methods in presenting research data to understand the problems in the research [7].

Development of the "MERIE" Learning Model

a. Analysis (Analysis)

This stage is carried out to determine the product to be developed. Students experience difficulties in learning the Network Infrastructure Administration learning material. Researchers analyzed the curriculum used by SMK Negeri 1 Siatas Barita. Researchers analyzed competencies which included an analysis of the Core Competencies (KI) and Basic Competencies (KD) contained in this application.

b. Design (Design)

This stage is carried out by taking 4 work steps, namely:

First, the researcher prepared an instrument for assessing the feasibility of learning media for material experts, media experts, learning practitioners and students.

Second, the researcher designed the MERIE learning model steps, namely:

I. Preliminary Activities:

1. Opener, 2. Motivation and Delivering Benefits

II. Core activities:

1. Activating student learning, 2. Strengthening material, 3. Implementation and Drawing Conclusions.

III. Closing Activities

Guiding students to conclude the material that has been studied, 2. Giving reflection tests, 3. Giving students the opportunity to continue their work at home, 4. Delivering the activity agenda for the next meeting, 5. Saying greetings to end the lesson

c. Development (Development), There are three steps in the development stage, namely First, the application of the "MERIE" (Motivation-Engagement-Reinforcement-Implementation-Evaluation) learning model. The second step taken after the development of the learning model product was completed was validating by material experts and media experts followed by validation by computer and network engineering learning practitioners in SMKs. After all revisions have been made, it continues to the next stage, namely the implementation stage.

d. Implementation (Implementation), the implementation phase is the product stage of the MERIE learning model with Cisco Packet Tracer application media tested on students. There are three stages in testing learning media products, namely individual trials, small group trials and field trials. Revisions are made after all stages of the trial if necessary.

Evaluation (Evaluation), the final stage of the ADDIE development procedure is evaluation. This evaluation stage compares the results obtained at each stage of evaluating the feasibility of learning media products in the form of network design simulations.

Data Collection Techniques in the form of: 1.Questionnaires, 2.Observations, 3.Learning Outcomes Tests, 4. Documentation.

Data analysis technique:

1.Average value

To determine the average value used the formula:

$$x=(\sum X)/n \text{ [4]} \quad (1)$$

2.Standard Deviation

To determine the standard deviation, the formula is used:

$$s = \sqrt{(\Sigma(xi-x)^2)/(n-1)} \quad (2)$$

For the population, the formula is used:

$$s = \sqrt{(\Sigma(xi-x)^2)/n} \quad (3)$$

where:

s = standard deviation

xi = data price i

n = number of samples

3. Normality test:

If Lcount <L table, then the sample is normally distributed

If Lcount > Ltable, then the sample is not normally distributed

4.Homogeneity Test

The variance homogeneity test is calculated using the F test, namely:

F = (largest variance)/(smallest variance) or $F = S1^2/S2^2$

Where:

$S1^2$ = variance of the larger group

$S2^2$ = Variance of the smaller group

Test criteria:

If Fcount <F table, then the samples have the same variance

If Fcount > Ftable, then the samples do not have the same variance.

5. Hypothesis testing:

H1: The developed MERIE learning model is able to improve student learning outcomes in class XI E of SMK Negeri 1 Siatas Barita

H0: The developed MERIE learning model is not able to improve the learning outcomes of class XI E students of SMK Negeri 1 Siatas Barita.

Product Effectiveness Test Data Analysis Techniques:

H0: $\mu 1=\mu 2$

H1: $\mu 1\neq\mu 2$

$\mu 1$ = average student learning outcomes control class

$\mu 2$ = Average student learning outcomes in the experimental class

H0 = There is no difference in student learning outcomes in the control class and class experiment

H1 = There are differences in student learning outcomes in the control class and class experiment

## 3 Results and Discussion

The results of the research data processing carried out show that there is a difference between the project-based "MERIE" learning model and the Cisco Packet Tracer application and the Discovery Learning learning model, namely that the average learning outcomes using the MERIE model are higher than learning outcomes using the Discovery Learning model.

From the test results using the t-test, the calculated t value = 5.51 and t table = 2.048. If we compare t count > t table, namely 5.51 > 2.048, thus there is a significant difference between the "MERIE" learning model and the Cisco Packet Tracer application and the Discovery Learning learning model. This can also be seen from the average posttest score taught with the "MERIE" learning model and the Cisco Packet Tracer application, which is 84.4, while the posttest result taught with the Discovery Learning learning model is 75. This data proves that the use of the model "MERIE" learning and the Cisco Packet Tracer application are better for improving student learning outcomes than using the Discovery Learning learning model.

**Implications**

From the findings and conclusions in the research on the development of the "MERIE" learning model and the Cisco Packet Tracer application, there are implications that are more useful than the learning model that has been used by learning practitioners or teachers and students in the learning process. The following are the implications in question, among others:

1. The 'MERIE' learning model (Motivation-Engagement-Reinforcement-Implementation-Evaluation) and the Cisco Packet Tracer Application which are the development of the Project Based Learning (PjBL) learning model are equipped with teaching modules in the form of

materials, pictures, practice questions, and also instructions for using the Cisco Packet Tracer application relating to material on evaluating and configuring VLANs on a network.

2. The 'MERIE' learning model (Motivation-Engagement-Reinforcement-Implementation-Evaluation) and the Cisco Packet Tracer Application are able to make a positive and practical contribution, especially in the implementation of the learning process for teachers or learning practitioners which provide effectiveness and convenience in implementing the learning process so that can improve student learning outcomes. So that the "MERIE" learning model and the Cisco Packet Tracer Application can be used as material for consideration for teachers in implementing the learning process in the material on Evaluating and Configuring VLANs on the Network.

3. In order to improve the quality of learning, the Head of School and the North Sumatra Province Humbahas Education Office Branch should encourage teachers to produce even better learning products by providing seminars, training, as well as supporting facilities for developing the competence of teachers for the sake of improvement quality of education in schools.

**Suggestion**

Based on the findings that have been described in the conclusions and implications of the research results, the following are some suggestions that can be put forward, including:

1. The principal as the highest leader in the school has control and motivation for teachers to use facilities in an effort to develop the learning process, especially facilities in the field of technology and also to increase the competence of teachers through education and technology training and seminars.

2. Teachers of competence in Computer and Network Engineering are expected to be more active and sensitive to technological developments in the world of education and learning through various media and also to be more creative in solving students' learning difficulties, because it can improve the quality of learning in the classroom.

3. Computer and Network Engineering competency competency teachers need to study and use the "MERIE" learning model and the Cisco Packet Tracer Application so that students can be more active in the learning process.

4. It is possible that the readiness of students to accept and implement the "MERIE" learning model and the Cisco Packet Tracer Application can have an impact on research results because not only do teachers have competence in treatment, students also need to have competence in the material.

5. With the limited time in the research, so that there are still many things that have not been implemented properly, it is necessary to do further research.

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