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Teacher Innovation to Facilitate Student Learning Experiences in Building Construction Cost Estimation Learning

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ABSTRAK

Program keahlian bisnis konstruksi dan properti memiliki kendala dalam kegiatan pembelajaran estimasi biaya konstruksi dan properti yaitu kurangnya waktu tatap muka di kelas. Kurangnya waktu tatap muka di kelas. Selain itu keterbatasan ruangan dan padatnya materi menyebabkan kegiatan pembelajaran tidak dapat berjalan dengan optimal. Penelitian ini bertujuan untuk membuat enriched virtual classroom dengan pendekatan STAD pada mata pelajaran estimasi biaya konstruksi. Penelitian ini merupakan penelitian pengembangan (R&D) dan menggunakan model PEDATI dalam mendesain pembelajaran. Subyek penelitian ini adalah mahasiswa yang mengambil Estimasi Biaya dan Konstruksi sejumlah 59 orang. Metode yang digunakan untuk mengumpulkan data yaitu observasi, wawancara dan kuesioner. Instrumen yang digunakan untuk mengumpulkan data yaitu kuesioner. Teknik analisis data yang digunakan yaitu teknik analisis deskriptif kualitatif dan kuantitatif. Hasi penelitian menghasilkan desain pembelajaran enriched virtual classroom. Pemilihan materi, bentuk diskusi STAD, tugas hingga formulir evaluasi diatur sedemikian rupa dan dipadukan dengan LMS yang digunakan. Dengan enriched virtual classroom, pembelajaran akan lebih bervariasi sehingga dapat memperkaya pengalaman siswa dalam belajar.

ABSTRACT

The construction and property business expertise program have obstacles in learning activities for Construction and Property Cost Estimation, namely the lack of face-to-face time in class. In addition, the limitations of space and the density of material cause learning activities not to run optimally. This study aims to create an enriched virtual classroom with a STAD approach on the subject of Construction Cost Estimation. This research is development research (R&D) and uses the PEDATI model in designing learning. The subjects of this study were 59 students who took Cost and Construction Estimates. The methods used to collect data are observation, interviews, and questionnaires. The instrument used to collect data is a questionnaire. The data analysis technique used is descriptive qualitative and quantitative analysis techniques. The results of the study resulted in an enriched virtual classroom learning design. Material selection, STAD discussion forms, assignments, and evaluation forms are arranged in such a way and combined with the LMS used. With the enriched virtual classroom, learning will be more varied to enrich the student learning experience.

1. INTRODUCTION

The world has changed, human lifestyles have also changed (Yusuf et al., 2020). This change is the result of the development of science and technology which finally, without realizing it, the world industry has entered the era of the Industrial Revolution 4.0 (Rafiola et al., 2020). The era of the industrial revolution 4.0 is certainly very impactful for the world of education (Syakur & Sabat, 2020). The world education standards in the 4.0 revolution era are always related to the application of technology in learning (Dakhi et al., 2020). Thus the way humans learn, gain knowledge and information also changes. The learning environment can be modified by combining online and face-to-face learning in the hope of increasing student interest in learning (Han et al., 2020). The learning model that is being widely used in the 4.0 revolution era is the model, *blended learning* namely by combining face-to-face learning and online learning to improve the quality of learning and education (Dahlia et al., 2019; Rahmadani, 2019). There are 4 classifications in *blended learning* developed by the Clayton Kristen Institute, namely *the rotation model, the flex model, the self-blend model, and the enriched virtual classroom* (Piedra & Yudintseva, 2020; Pivneva et al., 2020). *Enriched Virtual Classroom* is one of the classifications in *blended learning.* This learning model is an alternative learning model that is carried out remotely where the learning process is

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dominated by technology replacing all types of mandatory activities and face-to-face learning is only an additional supplement if needed (Jaya Saragih et al., 2020; Park, S., Ryu & McChesney, 2019). The *enriched virtual classroom* that is developed must be supported by a pedagogical model (Hossain, 2021; Lasamahu et al., 2021). The pedagogical model used is the *Student Team Achievement Division* (STAD) because according to research conducted by previous researcher discussing the meta-analysis of the Effect of Application of the Student Team Achievement Division (STAD) Learning Model in Improving Student learning outcomes in the construction skills program that are proven to significantly improve student learning outcomes in students in the skills program subjects (Elpisah & Bin-Tahir, 2019; Hutama & Suparji., 2021; Nuayi et al., 2018).

Based on observations at SMKN 3 Cikarang Barat, the Construction and Property Business expertise program has a problem in learning activities for Construction and Property Cost Estimation, namely the lack of face-to-face time in class. The lack of face-to-face time in class is caused by the time students study at school for only five hours per day a week (07.00-12.00) for all subjects. This is because SMKN 3 Cikarang Barat is due to limited classrooms and is still under construction. It was a competency subject that requires skills that must be mastered well by students. The density of the material in this learning plus the less study time in class and the less time for students to study because they are required to do internships for 3 months during class XI in the third semester, resulting in not all of these competency materials being taught face-to-face in class. Therefore, to overcome this, it is necessary to support learning resources, methods and learning models that students can use to overcome the lack of face-to-face time in class and can be accessed easily anywhere and anytime, quickly, effectively and efficiently by utilizing technology that is available in the student learning environment. All learning resources, methods and student learning models must be adapted to the demands of the curriculum and student learning needs (Ferri et al., 2020; Lalian et al., 2021; Qekaj-Thaqi & Thaqi, 2021) In this case, it is possible to develop an Enriched Virtual Classroom with a cooperative learning model, namely the Student Teams Achievement Division. This application is expected to be able to maximize cooperative teaching and learning activities because it is in accordance with Revolution 4.o as well as the era of disruption coupled with new normal conditions.

Another study conducted by previous researcher that discusses the meta-analysis of the Effect of the Application of the Student Team Achievement Division (STAD) Learning Model in Improving the Learning Outcomes of DPIB students which is proven to significantly improve student learning outcomes in DPIB students in the subject of expertise programs (Hutama & Suparji., 2021). The use of the STAD learning model is the simplest cooperative learning model so it is widely used in cooperative learning and emphasize the process *Student Team Learning* (Syakur & Sabat, 2020; Yulianto et al., 2020). One of the advantages of the STAD learning model is that each group consists of heterogeneous students. By forming heterogeneous groups, students are expected to more easily master learning materials through small group discussions and collaborations consisting of 4 to 5 people (Takko et al., 2020). In addition, previous study also found that STAD can meet the needs of students in critical thinking, problem solving together and integrating knowledge and experience (Silalahi et al., 2021). Based on the description above, there is no research that discusses the learning model in the subject of Construction Cost Estimation. It would be interesting if research and development of the Enriched Virtual Classroom learning model with a Cooperative Approach in Construction and Property Cost Estimation Subjects. It were carried out in the hope of improving students' experience in learn and be able to fulfill the learning objectives of the Construction and Property Cost Estimation subject, which is to be able to plan construction cost estimates. This study aims to create an enriched virtual classroom with a STAD approach in the subject of Construction Cost Estimation. The design of online learning begins with the formulation of learning outcomes, mapping materials, designing synchronous and asynchronous learning flows to selecting media and activities that are PEDATI steps. The STAD learning approach by forming heterogeneous groups, students are expected to more easily master learning materials through small group discussions and collaborations consisting of 4 to 5 people (Takko et al., 2020). In addition, STAD can meet the needs of students in critical thinking, problem solving together and integrating knowledge and experience (Silalahi et al., 2021).

2. METHODS

This research is part of research and development (R&D) in order to produce new product designs, test the effectiveness of existing products, as well as developing and creating a new product (Sugiyono, 2015). The purpose of this research is to create teacher innovation products in the subject of Construction Cost Estimation in civil engineering vocational education and to enrich student's learning experiences. The research begins by analyzing the problems that exist in the implementation of learning in

the Cost Estimation and Construction course. Then also problem analysis, analysis of students who will be the subject of research, analysis of available resources for learning. Enriched Virtual Classroom Development stages are show in Figure 1.

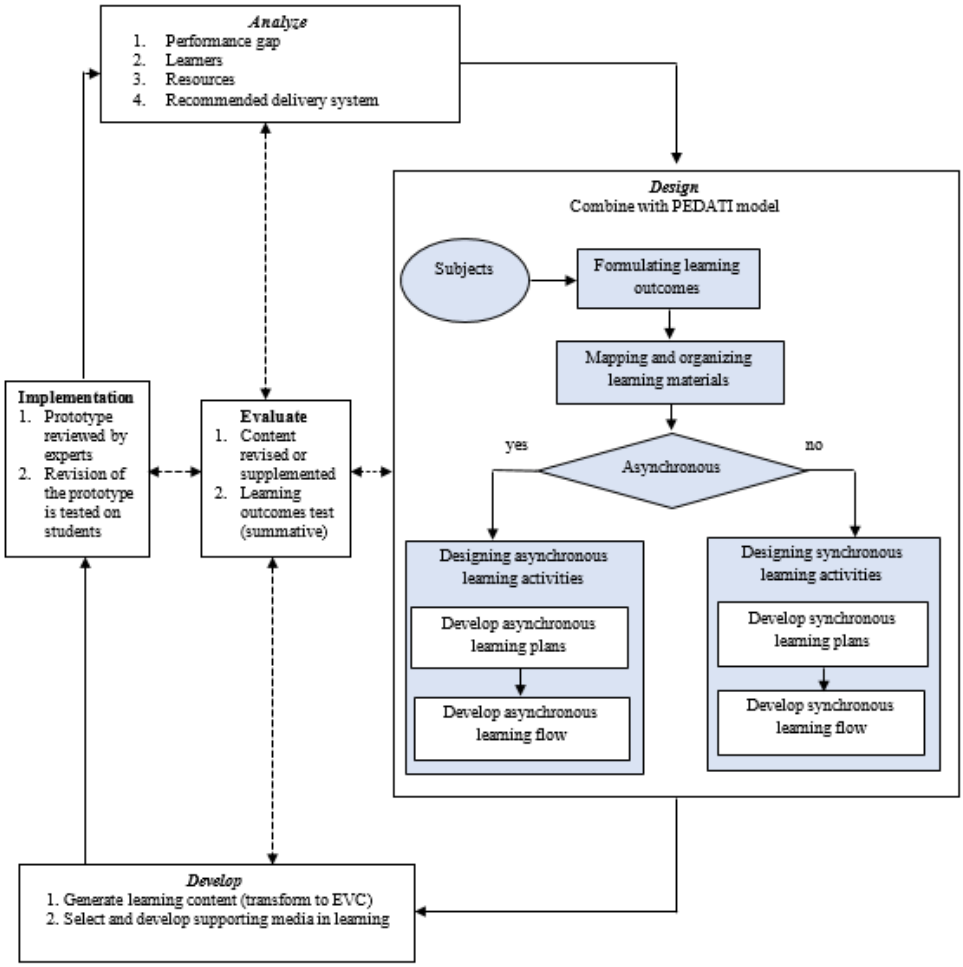

Figure 1. Enriched Virtual Classroom Development Flow

Base on Figure 1 the analysis stage consists of several activities, namely problem analysis, student analysis and resource analysis. Student analysis activities were carried out by distributing questionnaires to students with an average data of 16-17 years old and living not far from the school environment. Then also students are classified based on their learning outcomes, and analyze of available resources, namely content resources, technology resources, learning facilities, human resources and recommendations for learning delivery systems. The description of media assessment instrument grid is show in Table1.

Table 1. Media Assessment Instrument Grid

Component	Indicator	Data Collection Technique
1. Performance gap analysis	• Factual performance in the field • Expected performance in the field • The main causes of gaps in the field • Goal setting	• Observation • Unstructured interviews with subject teachers
2. Student analysis	• Main group of students (level/education level) • General characteristics of students, such as age, gender, use of technology, motivation, cognitive abilities, and skills • Number of students	• Interview with subject teachers • Student needs questionnaire

Component	Indicator	Data Collection Technique
	• Student location • Student experience level • Student attitude • Skills that students have that have the potential to succeed in a learning environment	
3. Resource availability analysis	• Content for reference • Technology in learning • Learning facilities • Human (HR)	• Observation • Interviews with subject teachers and the head of the light vehicle engineering study program
4. Recommended learning delivery system	• Identification of delivery options being considered • Estimate the length of time for each delivery option considered	

After the analysis is done, the next step is to make a learning design for the required material with Enriched Virtual Classroom media, followed by the design of asynchronous and synchronous learning activities. After the design is made, the next step is to develop media for synchronous and asynchronous learning. Next, the implementation of the learning model that has been reviewed by experts is carried out. The last stage is an evaluation in the form of a formative evaluation conducted by experts regarding whether or not revision or completion of content is necessary and a summative evaluation of the student learning outcomes test at the end of the activity.

The subject of this research is students that take Cost and Construction Estimates number of 59 people, Gender distribution: 31 male students, and 28 female students. This research take place at SMKN 3 Cikarang Barat . The data collected by observation, interview, documentation and data triangulation. Data obtained from instruments in the form of qualitative and quantitative data. Qualitative data in the form of assessment of suggestions and criticisms from learning design experts, media experts and material experts and students, while quantitative data is the assessment score of questionnaires or questionnaires that have been filled out by students. Data analysis techniques from the results of media expert test questionnaires, material experts and test questionnaire results conducted by students are obtained through assessment instruments using the Likert scale with 5 answer options. Student assessment instrument grid is show in Table 2.

Table 2. Student Assessment Instrument Grid

Component	Indicator	Number	scoring scale
Learning Aspect	• Clarity of learning objectives	1, 2, 3	
	• Clarity of material description and presentation of summary	4, 5	
Display Aspect	• Color composition	6	
	• The use of graphics in online learning media	7, 8	Scale 5
Program Aspects/ Compatibility	• Ease of accessing online learning components	9, 10, 11	
	• Learning material loading speed	12, 13	
Aspects of Language and Communication	• Readability level	14, 15	

3. RESULT AND DISCUSSION

Results

The result of this research is an learning design *enriched virtual classroom* with the PEDATI model combined with the STAD approach. Here is the procedure for developing enriched virtual classroom subjects Analyze, Design, Development, Implementation and Evaluation. The first step is to formulate learning outcomes. The formulation of this learning achievement must contain four ABCD elements, namely *Audience* (participant), *Behavior* (behavior), *Condition* (condition) and *Degree* (degree of learning achievement). The formulation of learning outcomes in the subject of construction cost estimation has one learning achievement which is then divided into six learning sub-achievements, (1) Given a contract documents and RKS*(C)*class XI student studying Business Construction and Property*(A)*can analyze the content of the contract documents and RKS*(B)*well and true (*D).* (2) By being given an example of a *work breakdown structure* (*C*), class XI students majoring in Construction and Property Business (*A*) can calculate the volume of building construction work (*B*) properly and correctly (*D*). (3) By being given a general description of the materials or materials commonly used in construction work (*C*), class XI students majoring in Construction and Property Business (*A*) can analyze the specifications of materials and materials for building construction work (*B*) properly and correctly (*D). (4)* By being given the basic concept of estimating construction costs (*C*) class XI students majoring in Construction and Property Business (*A*) can apply the methods and concepts for calculating building construction material needs (*B*) properly and correctly (*D*). (5) Given a list of local laws and regulations regarding standard *unit prices* for building materials, *wages* and job analysis for construction activities (*C*) class XI students majoring in Construction and Property Business (*A*) can calculate wages for building construction work (*B*) properly and correctly (*D*). (6) With the acquisition of prices unit wages (*C*) class XI students majoring in Construction and Property Business (*A*) can compile an analysis of the unit price of work (*B*) properly and correctly (*D*).

In the second step, after determining the formulation of learning outcomes, the second step is making a competency map. The competency map here aims to clarify what materials will be studied in the subject of construction cost estimation in class XI students of the building expertise program. (1) Types and Stages of Building, (2) . Calculation of the volume of building construction work. (3) Specifications of Materials Used. (4) Methods and Concepts for Calculation of Construction Material Requirements. (5) Wages for Building Construction Work. (6) Preparation of AHS. Then the third step is the mapping of learning materials that will be developed into an *enriched virtual classroom*. Mapping and organizing learning materials in the subject of construction cost estimation begins with the subject matter, sub-topics and ends with the subject matter of learning. Table 2 below is an example of mapping the learning materials developed. The fourth step is to choose synchronous and asynchronous learning. Based on the mapping and organization of the learning materials that will be developed in this *enriched virtual classroom* , the asynchronous and synchronous materials will be separated. In this step, the Learn stage is in the form of asynchronous and synchronous learning. In asynchronous learning, students can first study the material presented in the LMS. Learning can be in the form ofpresentations *powerpoint*, learning videos and can be in the form of text only. Then synchronous learning in the form of discussion forums in doing assignments with heterogeneous groups. Furthermore, for the Deepening stage, it can be in the form of guidance and consultation on the tasks that have been given. This consultation can be either virtual sync or live sync. Then at the Apply stage, students can calculate the unit price analysis of construction work and the last is the evaluation stage. The evaluation stage can be in the form of presenting the results of heterogeneous group discussions and the best group will be given an appreciation for good teamwork and on time. After analyzing the characteristics of students and their needs, this enriched virtual classroom will use the Edmodo platform, Zoom, Wordwall and learning videos connected to YouTube as well as using the STAD cooperative learning model. The diagram of the learning resources that will be used in the enriched virtual classroom with the STAD cooperative learning approach is show in Figure 2.

Base on Figure 2 in the development of the enriched virtual classroom, which is accompanied by the PEDATI model, we will use the Edmodo platform and video tutorials available on YouTube to study the learning materials independently (learning/learning). Furthermore, the understanding that has been obtained from independent learning will be deepened face-to-face using the zoom platform so that it can be better understood and minimize the differences in perceptions obtained (D Natural/deeping). After the virtual face-to-face meeting, students are invited to work on the assigned heterogeneous group task (Applying). Students can also consult either in person or through Edmodo regarding the assignments given. To evaluate (Evaluation) learning outcomes, students are given a quiz using the wordwall platform The fifth step is a mapping of synchronous and asynchronous learning. Synchronous learning activities are divided into two, namely direct synchronous and virtual synchronous. Meanwhile, asynchronous learning

activities can be divided into independent asynchronous and collaborative asynchronous, which includes media, evaluation tests, discussions and online assignments. The selection of each component is adjusted to the sub-topics and characteristics of the selected media or activity.

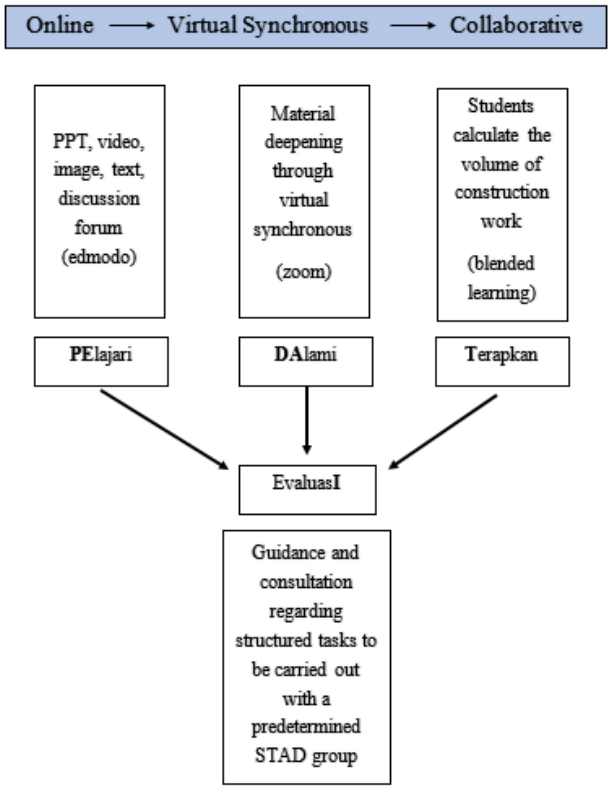

Figure 2. Combination of PEDATI model with STAD Learning

Discussion

Models of analysis of the use and acceptance of technologies are often used to evaluate the acceptance and use of technology, such as the Technology Acceptance Model (TAM) (Costa et al., 2018; Davis, 1989). This model is used to explain the acceptance and use of various technologies. TAM has two main constructs, namely perceived usefulness and ease of use of technology (Perceived Ease of Use). This TAM model is based on the Theory of Reasoned Action (TRA). In addition to TAM, there is also a current analysis model, the Unified Theory of Acceptance and Use of Technology (UTAUT). This research uses a model as a theoretical frame of thought, namely UTAUT which is used in electronic scoring systems. In accordance with the scope of research, the UTAUT model has been modified in such a way that it becomes simpler. This frame of mind chart gives an idea that there are a number of factors from performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) to Behavioral Intention to Use the System (BIUS) which will then be analyzed using SPSS analysis tools.

In Performance Expectancy, the higher the level of a person using the system will help them get better performance. A person who has high performance expectations is considered to have a good perception of the e-assessment system. This indicates an opportunity that someone wants to use the e-assessment system so that performance expectations can affect the wishes of NUADU users. In effort expectancy, a person who has a high level of business expectations is considered to have a good perception of the e-assessment system. Therefore, the hope of effort can affect a person's desire to use the e-assessment system. In social influence, a person who has a high level of social influence is considered to have a good perception of the e-assessment system. This indicates the higher the level of use of the e-assessment system so that social influence can affect a person's desire to use the e-assessment system. In facilitating conditions of facilities, a person's level of trust can be said to be the amount of perception of facilities that support the use of the system so that individual perception is strongly influenced by how good the facilities exist. The higher level of condition of a person's facilities, it is considered to have a good perception of the e-assessment system. Therefore the condition of the facility can influence a person to

use the e-assessment system. The position of this research on previous research is as a simpler study by modifying the UTAUT model to suit the scope conditions.

The result of this study is the enriched virtual classroom learning design with the PEDATI model combined with the STAD approach. This learning model is in accordance with the model that is currently popular, namely the blended learning model or combining face-to-face and virtual learning (Dahlia et al., 2019). Enriched Virtual Classroom is one of the classifications in blended learning. This learning model is an alternative learning model that is carried out remotely where the learning process is dominated by technology replacing all types of mandatory activities and face-to-face learning is only an additional supplement if needed (Jaya Saragih et al., 2020). The learning flow of the enriched virtual classroom is divided into two, namely asynchronous and synchronous. The asynchronous learning flow includes instructions, descriptions, a series of independent activities (digital media and quizzes) and collaborative activities (discussion forums and online assignments). While the synchronous learning flow includes activities that are "deep" using zoom. Students are free to consult regarding the assignments given by the teacher. The three components contained in this enriched virtual classroom are a pedagogical approach, learning strategies and learning technology (Lasamahu et al., 2021). The three components work as a system, supporting each other in creating virtual face-to-face learning models (Prawiradilaga & Chaeruman, 2018).

Enriched virtual classroom can be combined with any pedagogical approach according to need. However, in this study of Construction Cost Estimation, the STAD approach was used. In line with previous research that state STAD is the simplest cooperative learning model so it is widely used in cooperative learning and emphasizes the Student process *Team Learning* (Syakur et al., 2020; Yulianto et al., 2020). Than the use of stad also supported by the other researcher that state, one of the advantages of the STAD learning model is that each group consists of heterogeneous students (Silalahi et al., 2021; Takko et al., 2020). By forming heterogeneous groups, students are expected to more easily master learning materials through small group discussions and collaborations consisting of 4 to 5 people. In addition, STAD can meet the needs of students in critical thinking, problem solving together and integrating knowledge and experience STAD learning has 4 syntaxes, namely (1) Presenting learning material, (2) Discussing and discussing assignments or questions with the group that have been determined (heterogeneous) (3) Individual tests or can explain the results of group discussions and (4) Giving appreciation to the group by the highest score.

After completing all stages of the enriched virtual classroom learning design with the STAD approach, the next step is to prepare learning materials and prepare assignments along with task assessment instruments that will be done with heterogeneous groups. The group is determined by the subject teacher. Learning media is used according to needs and the LMS is also designed in such a way as to attract students' interest in participating in enriched virtual classroom learning. This research has advantages and also contributions that can be applied to learning in the form of implementing synchronous and asynchronous learning so that problems such as one of them is learning hours in class because students' prakerin activities can be resolved. Teachers are also able to create learning that is not limited to space so that outside effective learning hours learning activities can be carried out according to the agreed time. In addition to the advantages and contributions that are expected to be applied to Indonesian education, this research cannot be said to be perfect, so further research is needed in the form of evaluation of the implementation after this learning model is applied consistently by the teacher in the classroom. Another thing to note is that this research is not limited to the subject of Construction Cost Estimation only, but can also be applied to other subjects. So that further research is needed so that this learning model continues to be relevant in its application.

4. CONCLUSION

Enriched virtual classroom learning can help students to have rich learning resources and learning opportunities anywhere. The design starts from the formulation of learning outcomes, material mapping, designing asynchronous learning flows and selecting media and activities which are the steps of the PEDATI model. The STAD learning approach is used to follow the characteristics of students in the Construction Cost Estimation subject, which not only discusses theory but also the ability to analyze the costs needed to build a building. Enriched virtual classroom learning is designed by combining the steps in the PEDATI model with the STAD approach syntax. Material selection, discussion forms, assignments to evaluation forms can be arranged in such a way and combined with the LMS used. The learning design of enriched virtual classroom that is designed with the right learning activities can make learning more meaningful for students. With enriched virtual classroom learning, synchronous learning can be a means of discussion or deepening of material, not just delivering material.

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